SOIL SURVEY OF

St. Joseph County, Indiana

United States Department of Agriculture
Soil Conservation Service

In cooperation with
Purdue University
Agricultural Experiment Station

This is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and agencies of the States, usually the Agricultural Experiment Stations. In some surveys, other Federal and local agencies also contribute. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all who need the information, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was completed in the period 1967 to 1973. Soil names and descriptions were approved in 1973. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1973. This survey was made cooperatively by the Soil Conservation Service and the Purdue University Agricultural Experiment Station. It is part of the technical assistance furnished to the St. Joseph County Soil and Water Conservation District.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms and woodlands; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of St. Joseph County are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county in alphabetic order by map symbol and gives the capability classification, special crop group, tree and shrub group, and woodland group of each. It also shows the page where each soil is described and the page for the capability unit in which the soil has been placed.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the discussions of the capability units, the special crop groups, and the woodland groups.

Foresters and others can refer to the section "Use of the Soils for Woodland," where the soils of the county are grouped according to their suitability for trees.

Wildlife managers and others can find information about soils and wildlife in the section "Use of the Soils for Wildlife Habitat."

Community planners and others can read about soil properties that affect the choice of sites for dwellings, commercial buildings, and waste disposal facilities in the section "Town and Country Planning."

Engineers and builders can find, under "Engineering Uses of the Soils," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the section "Formation and Classification of the Soils."

Newcomers in St. Joseph County may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the county given in the section "Additional Facts About the County."

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Issued November 1977

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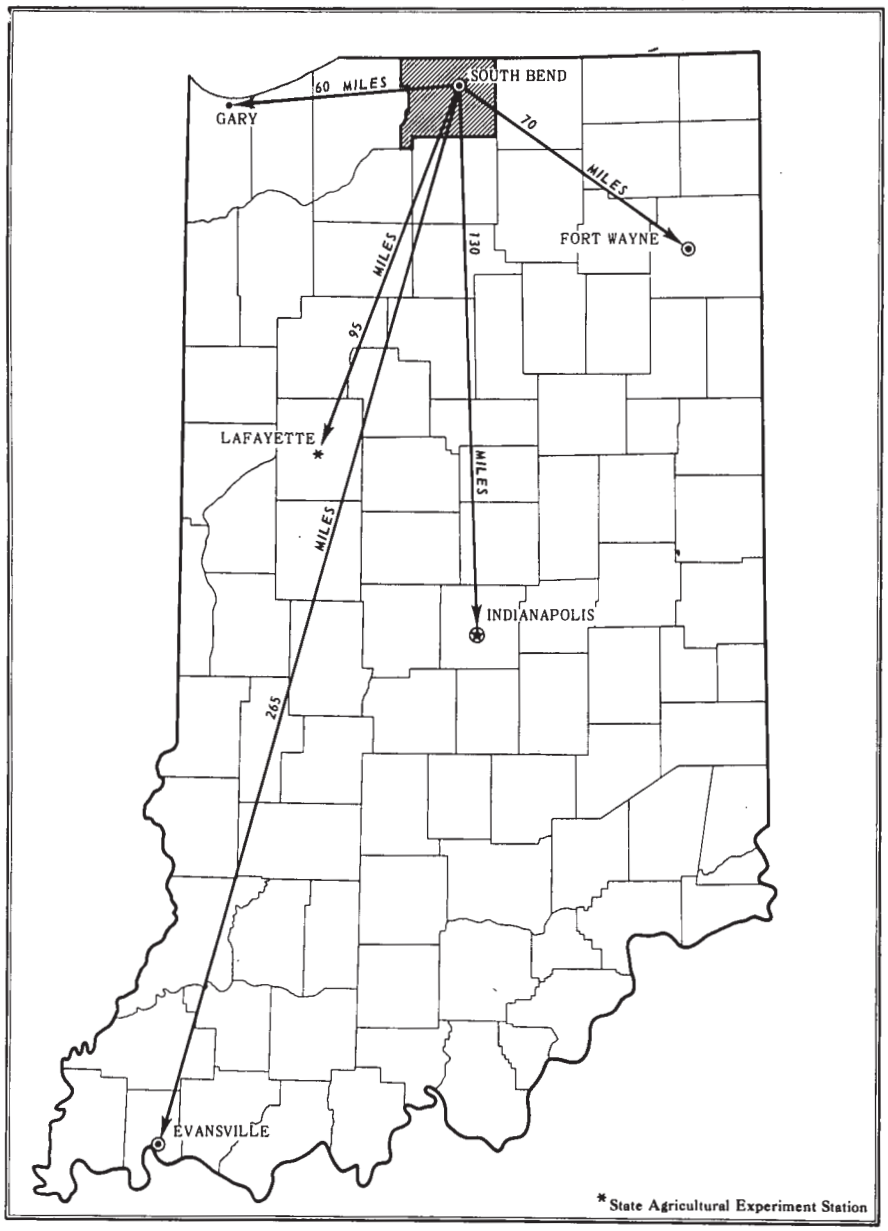

Location of St. Joseph County in Indiana.

SOIL SURVEY OF ST. JOSEPH COUNTY, INDIANA

Survey By Hezekiah Benton, Jr., Soil Conservation Service

Fieldwork By Hezekiah Benton, Jr., Ival D. Persinger, John R. Bernard, Jack M. Deal, Bobby L. Pirtle, and Jerry A. Thomas, Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service, in cooperation with the Purdue University Agricultural Experiment Station

ST. JOSEPH COUNTY is in the north central part of Indiana. It has a total area of 467 square miles, or 298,880 acres. The county is bordered on the north by Michigan, on the west by LaPorte County, on the east by Elkhart County, and on the south by Marshall County.

South Bend, the county seat, is about 96 miles east of Chicago. Other cities in the county are Granger, Lakeville, Mishawaka, New Carlisle, North Liberty, Walkerton, and Wyatt.

About 60 percent of the land in St. Joseph County is highly productive and is used for farming. The sale of farm products and high-value specialty crops is a significant source of revenue in the county.

The county, which is near the center of the Great Lakes industrial belt, has more than 350 manufacturing firms. Many people commute to St. Joseph County from both Indiana and Michigan.

Many educational institutions are located in the county, including the University of Notre Dame, St. Mary's College, an extension of Indiana University, Brothers of Holy Cross Junior College, Indiana Vocational and Technical School, and St. Francis Convent.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in St. Joseph County, where they are located, and how they can be used. The soil scientists went into the county knowing they would likely find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes, the size and speed of streams, the kinds of native plants or crops, the kinds of rock, and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or geographic feature near the place where a soil of that series was first observed and mapped. Riddles and Tyner, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Riddles loam, 6 to 12 percent slopes, eroded, is one of several phases within the Riddles series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map at the back of this publication was prepared from aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. One such kind of mapping unit, called a soil complex, is shown on the soil map of St. Joseph County.

A soil complex consists of areas of two or more soils, so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. Hillsdale complex,

6 to 12 percent slopes, eroded, is an example in St. Joseph County.

In most areas surveyed, there are places where the soil material is so rocky, so shallow, so severely eroded, or so variable that it has not been classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Alluvial land is a land type in this survey.

While a soil survey is in progress, soil scientists take soil samples needed for laboratory measurements and for engineering tests. Laboratory data from the same kind of soil in other places are also assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kind of soil. Yields under defined management are estimated for all the soils.

Soil scientists observe how soils behave when used as a growing place for native and cultivated plants and as material for structures, foundations for structures, or covering for structures. They relate this behavior to properties of the soils. For example, they observe that filter fields for onsite disposal of sewage fail on a given kind of soil, and they relate this to the slow permeability of the soil or to its high water table. They see that streets, road pavements, and foundations for houses are cracked on a named kind of soil, and they relate this failure to the high shrink-swell potential of the soil material. Thus, they use observation and knowledge of soil properties, together with available research data, to predict limitations or suitability of soils for present and potential uses.

After data have been collected and tested for the key, or benchmark, soils in the survey area, the soil scientists set up trial groups of soils. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. They then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under current methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in St. Joseph County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area or in planning engineering works, recreation facilities, and community developments. It is not a suitable map for planning the management of a farm or field or for selecting the exact location of a road, building, or other structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The soil associations on the general soil map in this soil survey do not fully agree with those on the general soil maps in soil surveys of adjacent counties. Differences in the maps are a result of improvements in the classification of soils, particularly the modification or refinement in soil series concepts. In addition, more precise and detailed maps are needed because the uses of the general soil maps have expanded in recent years. The more modern maps meet this need. Still another difference is caused by the range in slope that is permitted within associations in different surveys.

The soil associations in this survey have been grouped into general kinds of landscapes for broad interpretative purposes. Each of the broad groups and their included soil associations are described in the following pages. The terms for texture used in the title for several of the associations apply to the texture of the surface layer of the major soils. For example, in the title of Morley-Blount association, the words *medium textured and moderately fine textured* refer to the texture of the surface layer.

Dominantly Well-Drained to Excessively Drained, Nearly Level to Strongly Sloping Soils

The four associations in this group make up about 44 percent of the county. The soils in these associations are used for corn, soybeans, and grasses and legumes for forage. Many areas of strongly sloping soils along major streams are in hardwood trees.

The soils have slight and moderate limitations for most nonfarm uses.

1. Hillsdale-Oshtemo-Chelsea association

Deep, nearly level to strongly sloping, well-drained and excessively drained, moderately coarse textured and coarse textured soils on till plains, moraines, outwash plains, and terraces

This association makes up about 4 percent of the county. About 48 percent of the association is Hillsdale soils, 20 percent is Oshtemo soils, 20 percent is Chelsea soils, and the remaining 12 percent is minor soils (fig. 1).

Hillsdale soils are deep, nearly level to strongly sloping, and well drained. They are on till plains and moraines. The surface and subsurface layers are dark grayish-brown and brown sandy loam about 12 inches thick. The subsoil is 51 inches thick. It is dark-brown, firm sandy clay loam in the upper 12 inches; dark-brown, firm heavy sandy loam in the next 9 inches; yellowish-brown, friable sandy loam in the next 6 inches; yellowish-brown, friable light sandy loam in the next 13 inches; and friable loamy sand in the lower 11 inches. The underlying material is yellowish-brown sandy loam that extends to a depth of 72 inches.

Oshtemo soils are deep, nearly level to strongly sloping, and well drained. They are on outwash plains and terraces. The surface layer is very dark grayish-brown sandy loam about 6 inches thick. The subsurface

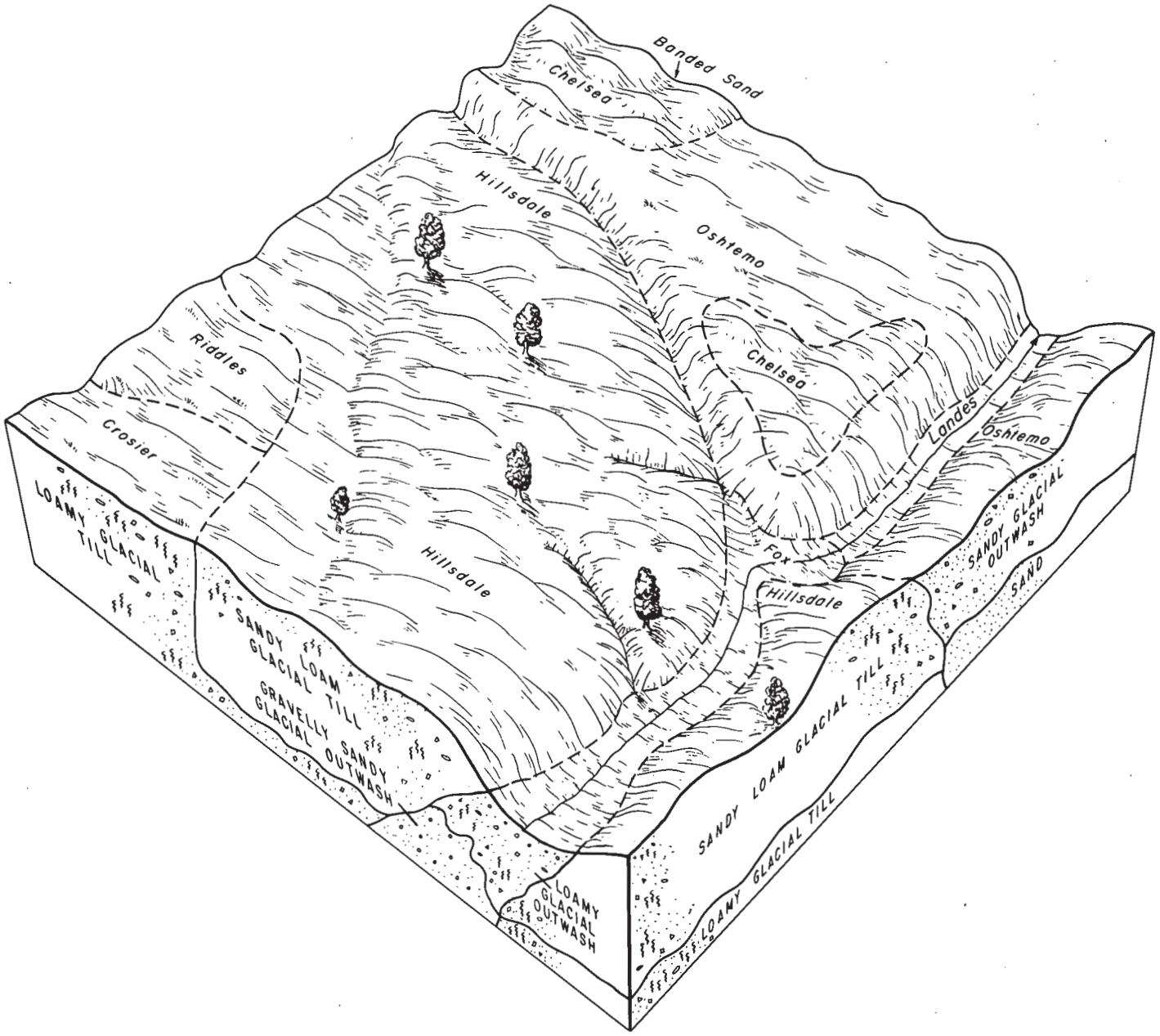

Figure 1.—Soils and underlying material in the Hillsdale-Oshtemo-Chelsea association.

layer is dark-brown sandy loam 10 inches thick. The subsoil is 38 inches thick. It is dark-brown, firm gravelly sandy clay loam in the upper 12 inches and strong-brown, friable loamy sand in the lower 26 inches. The underlying material is light yellowish-brown, stratified sand and gravelly sand that extends to a depth of 60 inches.

Chelsea soils are deep, nearly level to moderately sloping, and excessively drained. They are on outwash plains. The surface layer is dark-brown fine sand about 6 inches thick. The subsurface layer is light yellowish-brown fine sand 27 inches thick. The layer below that extends to a depth of 87 inches. It is light yellowish-brown, loose fine sand with bands of dark-brown friable sandy loam that are ⅛ to 1 inch thick and 1 to 4 inches apart.

Minor soils in this association are Riddles and Crosier soils on uplands, Martinsville and Fox soils on terraces, and Landes soils on bottom land.

About 60 percent of this association is used for housing subdivisions and industrial development. The rest is used for woodland, crops, and recreation areas.

Erosion and slope are main limitations of the soils for farming. A plan for water management is needed to control surface runoff. A soil stabilization plan is needed to reduce erosion and sediment.

The soils have slight or moderate limitations for septic tank absorption fields where slopes are less than 12 percent and severe limitations where slopes are more than 12 percent. Pollution of underground water supplies is a hazard on Oshtemo and Chelsea soils, however, especially near shallow wells. The soils have slight limitations for most other nonfarm uses.

2. *Oshtemo-Fox association*

Nearly level to strongly sloping, well-drained, moderately coarse textured soils that are deep and moderately deep over sand and gravelly sand; on outwash plains and terraces

This association makes up about 2 percent of the county. About 60 percent of the association is Oshtemo soils, 20 percent is Fox soils, and the remaining 20 percent is minor soils.

Oshtemo soils are deep, nearly level to strongly sloping, and well drained. They are on outwash plains and terraces. The surface and subsurface layers are very dark grayish-brown and dark-brown sandy loam about 16 inches thick. The subsoil is 38 inches thick. It is dark-brown, firm gravelly sandy clay loam in the upper 12 inches and strong-brown, friable loamy sand in the lower 26 inches. The underlying material is light yellowish-brown, stratified sand and gravelly sand that extends to a depth of 60 inches.

Fox soils are moderately deep over sand and gravelly sand, nearly level to moderately sloping, and well drained. They are on outwash terraces. The surface layer is dark-brown sandy loam about 8 inches thick. The subsurface layer is brown gravelly sandy loam 4 inches thick. The subsoil is 26 inches thick. It is dark-brown, firm gravelly sandy clay loam in the upper 8 inches; strong-brown, friable sandy loam in the next 6 inches; and dark-brown, firm gravelly clay loam in the lower 12 inches. The underlying material is yellowish-brown sand and gravelly sand that extends to a depth of 60 inches.

Minor soils in this association are Elston and Dickinson soils on outwash plains and terraces and Landes soils on bottom land.

The soils in this association are used mainly for woodland and pasture. Some areas are used for crops. These soils tend to be droughty in years when rainfall is below normal.

Limitations for septic tank absorption fields are slight where slopes are 0 to 6 percent, moderate where slopes are 6 to 12 percent, and severe where slopes are more than 12 percent. Pollution of underground water supplies is a hazard, however, especially near shallow wells. The soils have slight limitations for most other nonfarm uses.

3. *Tyner-Oshtemo association*

Deep, nearly level to strongly sloping, well-drained, coarse textured and moderately coarse textured soils on outwash plains and terraces

The association makes up about 31 percent of the county. About 45 percent of the association is Tyner soils, 40 percent is Oshtemo soils, and the remaining 15 percent is minor soils (fig. 2).

Tyner soils are deep, nearly level to strongly sloping, and well drained. They are on outwash plains and terraces. The surface layer is very dark brown loamy sand about 9 inches thick. The subsoil is 35 inches thick. It is dark-brown, very friable loamy sand in the upper 16 inches and dark yellowish-brown, very friable loamy sand in the lower 19 inches. The underlying material is yellowish-brown and dark-brown sand that extends to a depth of 70 inches.

Oshtemo soils are deep, nearly level to strongly sloping, and well drained. They are on outwash plains and terraces. The surface and subsurface layers are very dark grayish-brown and dark-brown sandy loam about 16 inches thick. The subsoil is 38 inches thick. It is dark-brown, firm gravelly sandy clay loam in the upper 12 inches and strong-brown, friable loamy sand in the lower 26 inches. The underlying material is light yellowish-brown, stratified sand and gravelly sand that extends to a depth of 60 inches.

Minor soils in this association are Chelsea, Brems, Maumee, Brady, and Tedrow soils on outwash plains and Fox and Tracy soils on outwash plains and terraces.

About 15 percent of this association is in crops. The rest is in pasture, woodland, housing subdivisions, and industrial developments. The woodland is on the steeper soils and along the St. Joseph River.

Droughtiness and soil blowing are the main limitations of the soils for farming. Using crop residue, winter cover crops, and green-manure crops helps reduce soil blowing and conserve soil moisture.

The soils have slight or moderate limitations for septic tank absorption fields where slopes are less than 12 percent and severe limitations where slopes are more than 12 percent. Pollution of underground water supplies is a hazard, however, especially near shallow wells. The soils have slight limitations for most other nonfarm uses.

4. *Coupee-Tracy association*

Deep, nearly level to moderately sloping, well-drained, medium-textured and moderately coarse textured soils on outwash plains and terraces

The association makes up about 7 percent of the county. About 60 percent of the association is Coupee soils, 35 percent is Tracy soils, and the remaining 5 percent is minor soils.

Coupee soils are deep, nearly level, and well drained. They are on outwash plains. The surface layer is black silt loam about 14 inches thick. The subsoil is 38 inches thick. It is brown, friable heavy silt loam in the upper 7 inches; brown, firm light clay loam in the next 5 inches; dark yellowish-brown, firm light clay loam in the next 7 inches; and dark-brown loamy sand and sand in the lower 19 inches. The underlying material is stratified fine sand, sand, and very shaly coarse sand that extends to a depth of 72 inches.

Tracy soils are deep, nearly level to moderately sloping, and well drained. They are on outwash plains and terraces. The surface layer is dark grayish-brown sandy loam about 9 inches thick. The subsoil is 33 inches thick. It is brown, firm loam in the upper 7 inches; dark-brown, firm loam in the next 6 inches; dark-brown, friable sandy loam in the next 5 inches;

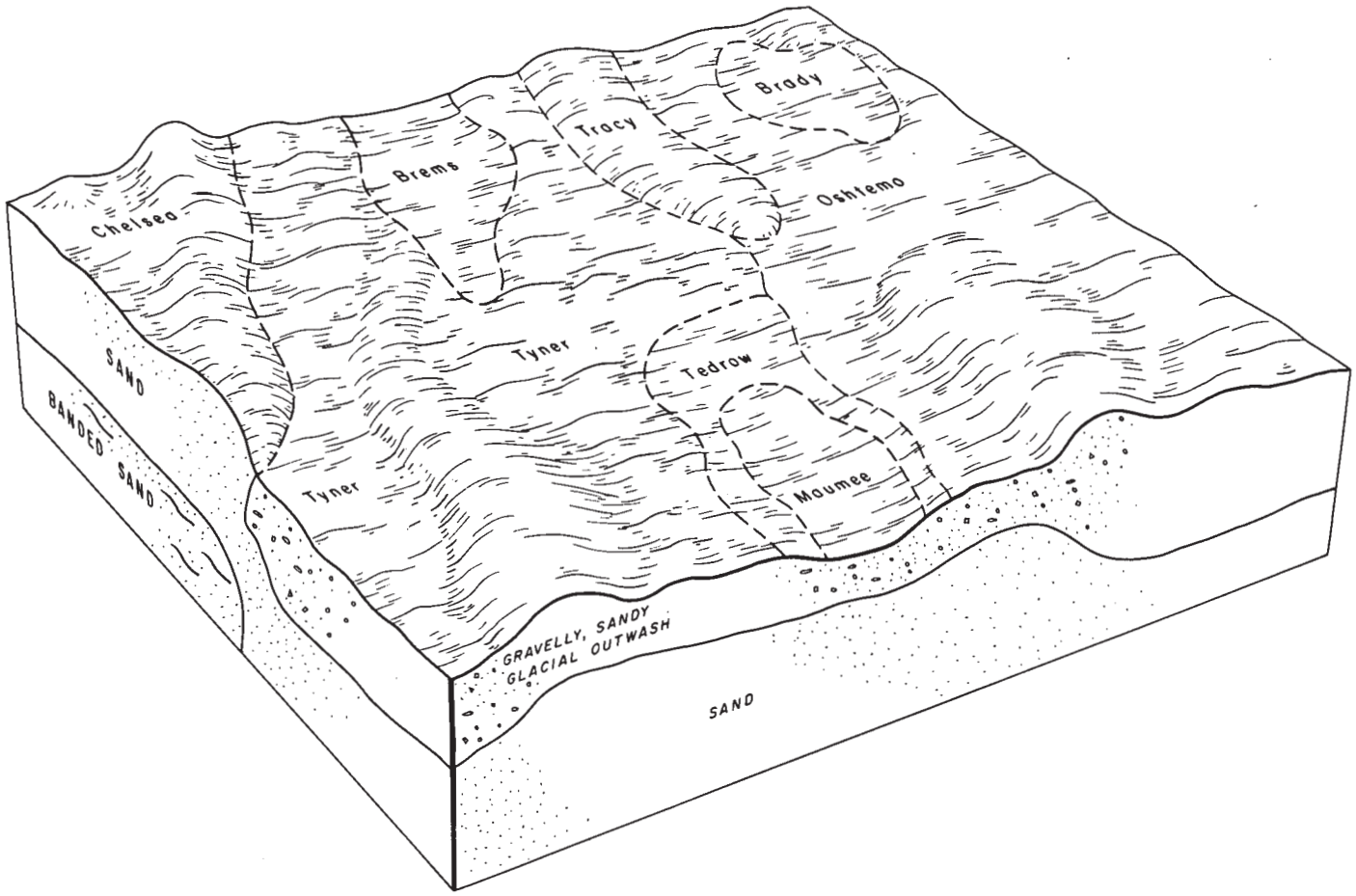

Figure 2.—**Soils and underlying material in the Tyner-Oshtemo association.**

and dark-brown, friable gravelly loamy sand in the lower 10 inches. The underlying material is brown sand that extends to a depth of 60 inches.

Minor soils in this association are Troxell soils in depressions on outwash plains and Alida soils on outwash plains and terraces.

The soils in this association are used mainly for crops. They are well suited to corn, soybeans, small grain, and grasses and legumes (fig. 3).

The major management needs are maintaining the organic-matter content, fertility, and tilth. Using crop residue, minimum tillage, winter cover crops, and green-manure crops help maintain the organic-matter content in the surface layer and improve tilth.

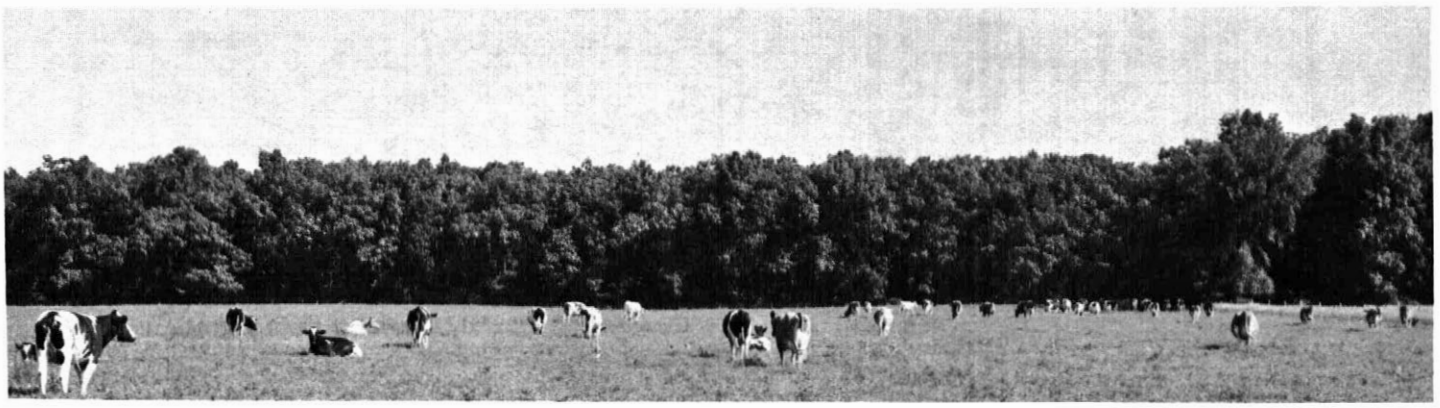

Figure 3.—**Dairy herd in a pasture of brome and alfalfa on Coupee silt loam, 0 to 2 percent slopes.**

The soils have only slight limitations for septic tank absorption fields. Pollution of underground water supplies is a hazard, however, especially near shallow wells. These soils have few limitations for most other nonfarm uses.

Dominantly Somewhat Poorly Drained to Very Poorly Drained, Nearly Level, Gently Sloping, and Depressional Soils

The two associations in this group make up about 34 percent of the county. Where they are adequately drained, the soils in these associations are used primarily for corn and soybeans. Some areas are used for specialty crops.

The soils have severe limitations for most nonfarm uses because of a seasonal high water table.

5. *Rensselaer-Gilford-Maumee association*

Deep, depressional and nearly level, very poorly drained, medium-textured, moderately coarse textured, and coarse textured soils on outwash plains

This association makes up about 11 percent of the county. About 31 percent of the association is Rensselaer soils, 20 percent is Gilford soils, 17 percent is Maumee soils, and the remaining 32 percent is minor soils (fig. 4.)

Rensselaer soils are deep, depressional and nearly level, and very poorly drained. They are on outwash plains. The surface layer is black loam about 11 inches thick. The subsoil is 30 inches thick. It is mottled, grayish-brown, firm loam in the upper 6 inches; gray, firm clay loam in the next 9 inches; light brownish-gray, friable, stratified sandy loam and loamy sand in the next 12 inches; and grayish-brown, friable sandy clay loam in the lower 3 inches. The underlying material is light brownish-gray loamy sand that extends to a depth of 60 inches.

Gilford soils are deep, depressional and nearly level, and very poorly drained. They are on outwash plains. The surface layer is sandy loam about 14 inches thick. It is black in the upper part and very dark gray in the lower part. The subsoil is 24 inches thick. It is mottled, gray, friable sandy loam in the upper 6 inches; mottled, gray, firm heavy sandy loam in the next 12 inches; and mottled, gray, very friable loamy sand in the lower 6 inches. The underlying material is gray sand that extends to a depth of 60 inches.

Maumee soils are deep, depressional and nearly level, and very poorly drained. They are on outwash

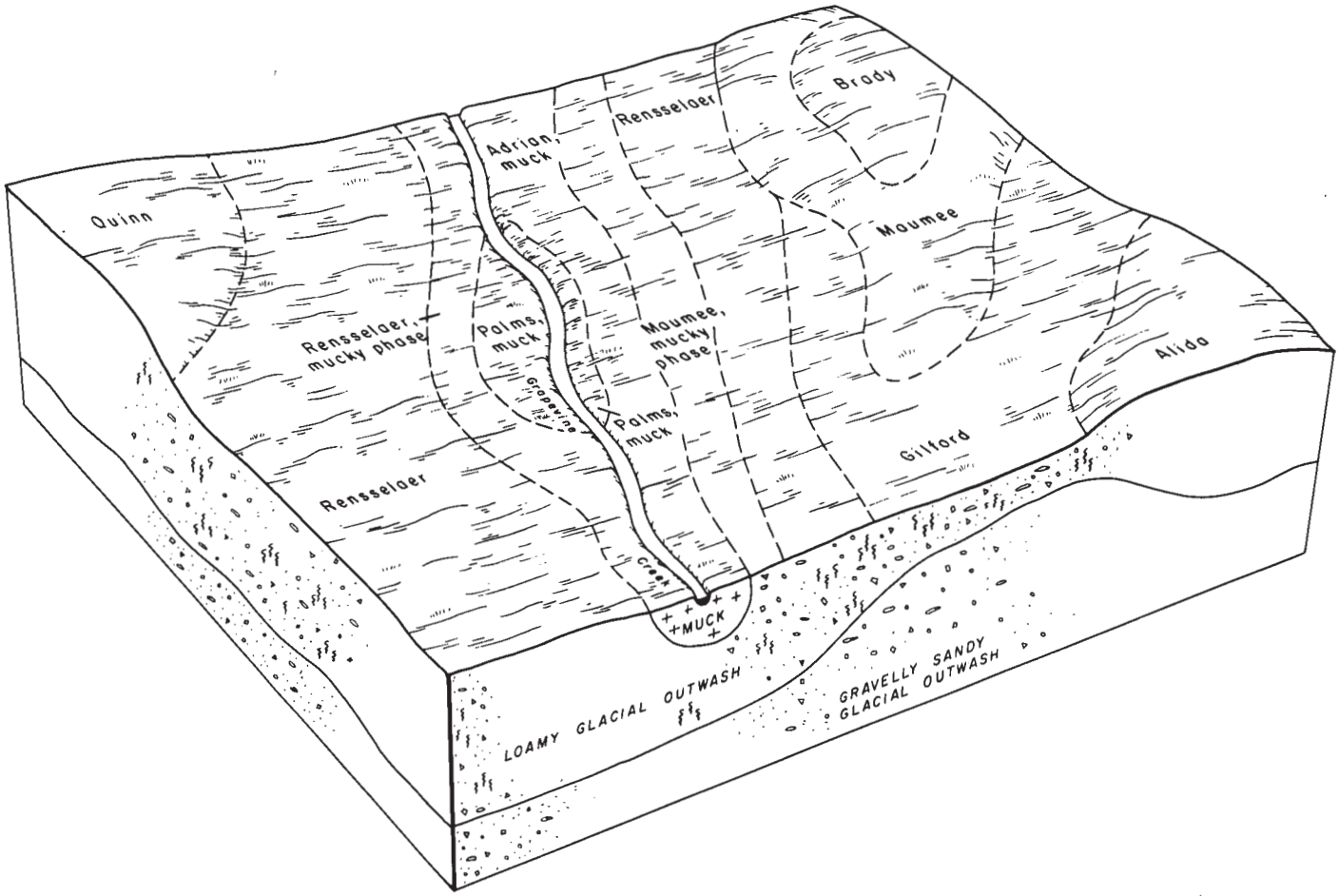

Figure 4.—Soils and underlying material in the Rensselaer-Gilford-Maumee association.

plains. The surface layer is loamy fine sand about 14 inches thick. It is very dark gray in the upper part and very dark grayish brown in the lower part. The underlying material extends to a depth of 65 inches. It is dark-gray, friable fine sand in the upper 14 inches; light brownish-gray, friable fine sand in the next 4 inches; gray, friable sand in the next 16 inches; gray, loose sand in the next 7 inches; and gray sand below that.

Minor soils in this association are Quinn, Alida, and Brady soils, mainly on rises on the outwash plains, and Adrian and Palms soils on muck flats and in depressions.

The soils in this association are used mainly for crops. Most are well suited to intensive row cropping if they are adequately drained. Corn and soybeans are the main crops. Other crops include small grain and grasses and legumes for forage.

Wetness and soil blowing are the major limitations of the soils for farming. A suitable drainage system needs to be established and maintained for maximum production.

The soils have severe limitations for septic tank absorption fields because they have a seasonal high water table. They also have severe limitations for most other nonfarm uses.

6. Crosier-Brookston-Milford association

Deep, depressional and nearly level to gently sloping, somewhat poorly drained to very poorly drained, medium-textured and moderately fine textured soils on till plains and lake plains

This association makes up about 23 percent of the county. About 40 percent of the association is Crosier soils, 33 percent is Brookston soils, 10 percent is Milford soils, and the remaining 17 percent is minor soils.

Crosier soils are deep, nearly level to gently sloping, and somewhat poorly drained. They are on till plains. The surface layer is dark grayish-brown loam about 8 inches thick. The subsurface layer is mottled, grayish-brown loam 3 inches thick. The subsoil is 27 inches thick. It is mottled, grayish-brown, firm clay loam in the upper 9 inches; mottled, yellowish-brown, firm light clay loam in the next 10 inches; and mottled, brown, firm loam in the lower 8 inches. The underlying material is mottled, brown loam that extends to a depth of 60 inches.

Brookston soils are deep, depressional to nearly level, and very poorly drained. They are on till plains. The surface layer is very dark gray silty clay loam about 15 inches thick. The subsoil is 31 inches thick. It is mottled, dark-gray, firm clay loam in the upper 8 inches; mottled, gray, firm clay loam in the next 13 inches; and mottled, yellowish-brown, firm clay loam in the lower 10 inches. The underlying material is mottled, brown loam that extends to a depth of 72 inches.

Milford soils are deep, depressional to nearly level, and poorly drained. They are on lake plains. The surface layer is very dark gray silty clay loam about 15 inches thick. The subsoil is 31 inches thick. It is mottled, gray, firm heavy silty clay loam in the upper 17 inches and mottled, gray, firm silty clay loam in the lower 14 inches. The underlying material is mottled, yellowish-brown, stratified loam, clay loam, and sandy loam that extends to a depth of 72 inches.

Minor soils in this association are Whitaker, Rensselaer, and Del Rey soils on terraces and Aubbeenaubbee soils on uplands.

The soils in this association are used mainly for crops. If they are adequately drained, the soils are well suited to intensive row cropping. Corn and soybeans are the main crops.

Wetness is the main limitation of the soils for farming. A suitable drainage system needs to be established and maintained for maximum production. Terraces, waterways, and minimum tillage help control runoff and erosion on the gently sloping soils.

The soils have severe limitations for septic tank absorption fields because they have a seasonal high water table. They also have severe limitations for most other nonfarm uses.

Dominantly Well-Drained to Somewhat Poorly Drained, Nearly Level to Strongly Sloping Soils

The two associations in this group make up about 12 percent of the county. The nearly level to moderately sloping soils in these associations are used primarily for corn and soybeans. The strongly sloping soils are used for grasses and legumes for forage and for hardwood trees.

The soils have moderate to severe limitations for most nonfarm uses.

7. Morley-Blount association

Deep, nearly level to strongly sloping, well-drained to somewhat poorly drained, medium-textured to moderately fine textured soils on till plains and moraines

This association makes up about 1 percent of the county. About 50 percent of the association is Morley soils, 22 percent is Blount soils, and the remaining 28 percent is minor soils.

Morley soils are deep, gently sloping to strongly sloping, and moderately well drained and well drained. They are on dissected glacial till plains and moraines. The surface layer is about 10 inches thick. It is dark-brown silt loam in the upper part and light-brown silty clay loam in the lower part. The subsoil is 28 inches thick. It is yellowish-brown, firm silty clay loam in the upper 7 inches; yellowish-brown, very firm silty clay loam in the next 15 inches; and brown, firm silty clay loam in the lower 6 inches. The underlying material is brown clay loam that extends to a depth of 60 inches.

Blount soils are deep, nearly level, and somewhat poorly drained. They are on glacial till plains and moraines. The surface layer is grayish-brown silt loam about 10 inches thick. The subsoil is 24 inches thick. It is mottled, gray, friable silty clay loam in the upper 7 inches and mottled, yellowish-brown, firm silty clay in the lower 17 inches. The underlying material is mottled, grayish-brown silty clay loam that extends to a depth of 60 inches.

Minor soils in this association are Riddles and Miami soils on uplands, Milford soils in slight depressions and in slack water areas on terraces, and Washtenaw soils in the slight depressions on uplands and terraces.

About half of this association is in crops, and half is in woodland and pasture.

Runoff, erosion, and wetness are the main limitations of the soils for farming. A water management plan is needed to control surface runoff. A soil stabilization plan is needed to reduce erosion and sediment. The use of winter cover crops, green-manure crops, and crop residue helps to maintain the organic-matter content and fertility, improve tilth, and control erosion. Terraces, waterways, and minimum tillage help control runoff and erosion. For maximum crop production, a suitable drainage system needs to be established and maintained on the Blount soils.

The soils have severe limitations for septic tank absorption fields because of their slow permeability. They also have severe limitations for most other nonfarm uses.

8. *Riddles-Miami-Crosier association*

Deep, nearly level to strongly sloping, well-drained and somewhat poorly drained, medium-textured and moderately fine textured soils on till plains

This association makes up about 11 percent of the county. About 44 percent of the association is Riddles soils, 14 percent is Miami soils, 12 percent is Crosier soils, and the remaining 30 percent are minor soils (fig. 5).

Riddles soils are deep, nearly level to strongly sloping, and well drained. They are on glacial till plains. The surface layer is dark grayish-brown loam about 9 inches thick. The subsoil is 53 inches thick. It is dark yellowish-brown, firm loam in the upper 3 inches; dark yellowish-brown, firm clay loam in the next 18 inches; yellowish-brown, firm light clay loam in the next 16 inches; and brown, firm loam in the lower 16 inches. The underlying material is brown loam that extends to a depth of 72 inches.

Miami soils are deep, gently sloping to strongly sloping, and well drained. They are on glacial till plains. The surface layer is dark-brown loam about 8 inches thick. The subsurface layer is brown loam 6 inches thick. The subsoil is 24 inches thick. It is dark yellowish-brown, firm clay loam in the upper 6 inches and dark-brown, firm clay loam in the lower 18 inches. The underlying material is brown heavy loam that extends to a depth of 60 inches.

Crosier soils are deep, nearly level to gently sloping, and somewhat poorly drained. They are on glacial till plains. The surface layer is dark grayish-brown loam about 8 inches thick. The subsurface layer is mottled, grayish-brown loam 3 inches thick. The subsoil is 27 inches thick. It is mottled, grayish-brown, firm clay loam in the upper 9 inches; mottled, yellowish-brown, firm light clay loam in the next 10 inches; and mottled,

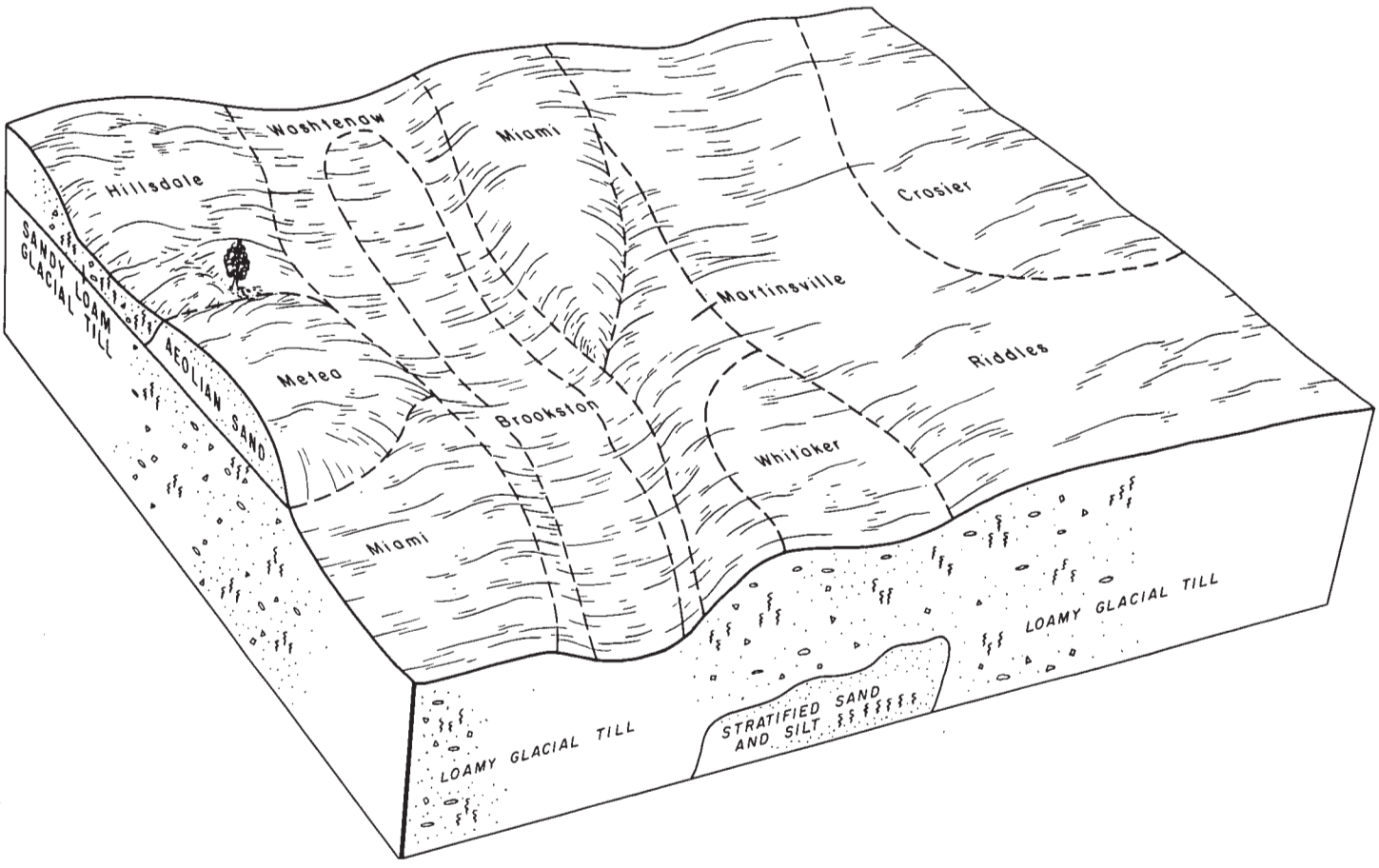

Figure 5.—Soils and underlying material in the Riddles-Miami-Crosier association.

brown, firm loam in the lower 8 inches. The underlying material is mottled, brown loam that extends to a depth of 60 inches.

Minor soils in this association are Hillsdale, Metea, Brookston, Washtenaw, Martinsville, Rensselaer, and Whitaker soils. Hillsdale and Metea soils are on uplands, and Brookston and Washtenaw soils are in depressions on uplands. Martinsville soils are on terraces, and Rensselaer soils are in depressions on terraces. Whitaker soils are on outwash plains.

About 70 percent of this association is used for crops, and the rest is used for woodland, pasture, and urban development. Corn, soybeans, small grain, and grasses and legumes for forage are the main crops.

Erosion, the slopes of the Riddles and Miami soils, and wetness of the Crosier soils are the major limitations of the soils for farming. A water management plan is needed to control surface runoff on the sloping soils. A soil stabilization plan is needed to reduce erosion and sediment. The use of winter crops, green-manure crops, and crop residue helps maintain the organic-matter content and fertility, improve tilth, and control erosion. Terraces, waterways, and minimum tillage help control runoff. For maximum crop production, a suitable drainage system needs to be established and maintained on the Crosier soils.

Riddles and Miami soils have moderate limitations for septic tank absorption fields where slopes are less than 12 percent and severe limitations where slopes are more than 12 percent. Crosier soils have severe limitations for septic tank absoption fields because of their seasonal high water table and moderately slow permeability. The soils in this association have moderate limitations for most other nonfarm uses (fig. 6).

Dominantly Very Poorly Drained, Depressional and Nearly Level, Organic Soils

The association in this group makes up about 10 percent of the county. The soils in this association parallel the Kankakee River and Grapevine Ditch. Where they are adequately drained, mainly they are used for corn, soybeans, and specialty crops.

The soils have severe limitations for most nonfarm uses.

9. Houghton-Adrian-Palms association

Deep, depressional and nearly level, very poorly drained, organic soils on lake plains, outwash plains, and till plains

***Figure 6.*—Expanding industry and housing on soils of the Riddles-Miami-Crosier association.**

This association makes up about 10 percent of the county. About 36 percent of the association is Houghton soils, 34 percent is Adrian soils, 10 percent is Palms soils, and the remaining 20 percent is minor soils.

Houghton soils are deep, depressional and nearly level, and very poorly drained organic soils. They are on lake plains and bogs. The surface layer is black muck about 9 inches thick. The layer below that is black muck 7 inches thick. The next layer is black, friable muck 7 inches thick. Below that for 10 inches is dark reddish-brown friable muck. The layer below that is reddish-brown, friable muck 21 inches thick. The underlying material is gray sand that extends to a depth of 60 inches.

Adrian soils are deep, depressional and nearly level, and very poorly drained organic soils. They are on the Kankakee muck flats and outwash plains. The surface layer is black muck about 13 inches thick. The layer below that is dark reddish-brown, friable muck 8 inches thick. The underlying material is 39 inches thick. It is white fine sand in the upper 6 inches; light brownish-gray sand in the next 8 inches; strong-brown and light brownish-gray sand in the next 7 inches; and mottled, dark-gray sand in the lower 18 inches.

Palms soils are deep, depressional and nearly level, and very poorly drained organic soils. They are on the Kankakee muck flats and till plains. The surface layer is black muck about 12 inches thick. The layer below that is dark reddish-brown, friable muck 9 inches thick. The underlying material extends to a depth of 60 inches. It is mottled, very dark gray loam in the upper 5 inches; mottled, gray clay loam in the next 14 inches; and grayish-brown heavy sandy loam in the lower 20 inches.

Minor soils in this association are Edwards soils, Maumee mucky loamy fine sand, and Rensselaer mucky loam on broad, depressional flats.

The soils in this association are used mostly for crops (fig. 7), mainly corn and soybeans. A large acreage is used for special crops, including potatoes, mint, onions, and cabbage.

Wetness and soil blowing are the main limitations of these soils for farming. An adequate drainage system must be installed for crops. Windbreaks help control soil blowing.

These soils have severe limitations for septic tank absorption fields because of wetness. They also have severe limitations for most other nonfarm uses.

Descriptions of the Soils

This section describes the soil series and mapping units in St. Joseph County. Each soil series is described in detail, and then, briefly, each mapping unit in that series. Unless it is specifically mentioned otherwise, it is to be assumed that what is stated about the soil series holds true for the mapping units in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the soil series to which it belongs.

An important part of the description of each soil series is the soil profile, that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second is much more detailed and is for those who need to make thorough and precise studies of soils. Color terms are for moist soil unless otherwise stated. The symbol following color names in the representative profile descriptions refers to a standard color notation called a Munsell notation. The profile described in the series is representative for mapping units in that series. If the profile of a given mapping unit is different from the one described for the series, these differences are stated in describing the mapping unit, or they are differences that are apparent in the name of the mapping unit.

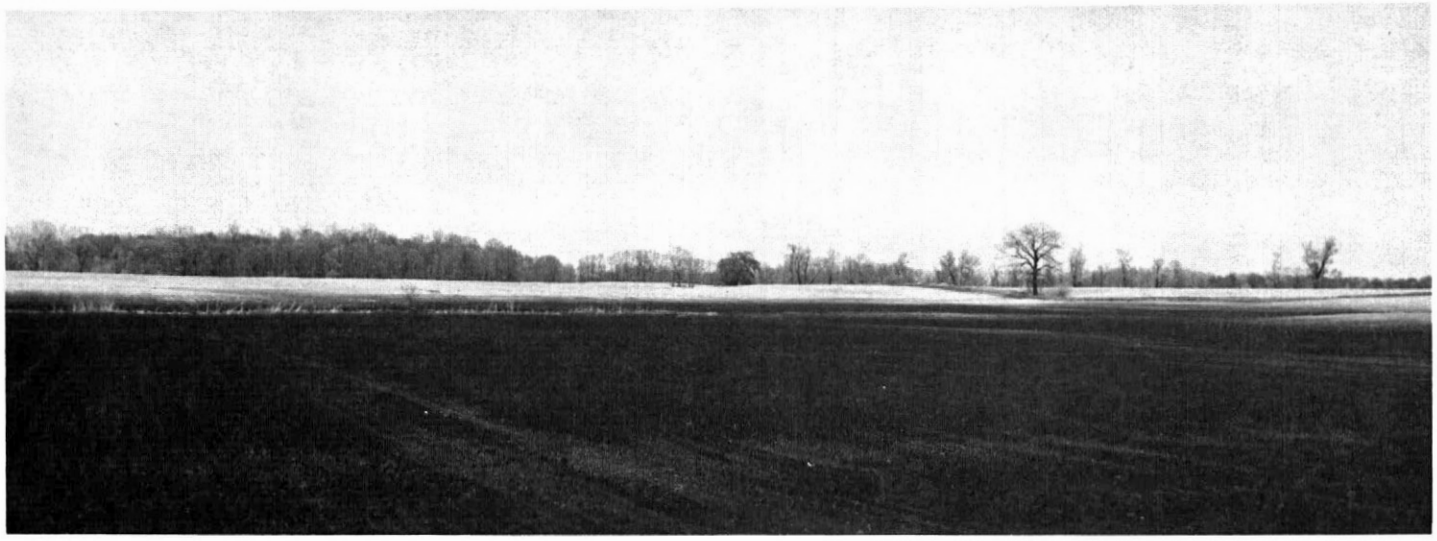

Figure 7.—Typical landscape in the Houghton-Adrian-Palms association.

As mentioned in the section "How This Survey Was Made," not all mapping units belong to a soil series. Alluvial land, for example, does not belong to a soil series, but nevertheless is listed in alphabetic order along with the soil series.

Preceding the name of each mapping unit is a symbol that identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit is the capability unit and woodland group in which the mapping unit has been placed. The page for the description of each capability unit, woodland group, or other interpretative group is listed in the "Guide to Mapping Units" at the back of this survey.

The acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the "Glossary" at the end of this survey, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*6*).[1]

Descriptions, names, and mapped areas of soils in this soil survey do not fully agree with those in soil surveys of adjacent counties. Differences are the result of better knowledge of soils, modification in series concepts, intensity of mapping, and the extent of soils within the survey. In some places it is more practical to combine small acreages of similar soils that respond to use and management in much the same way than it is to separate these soils and give them names.

[1] Italic numbers in parentheses refer to Literature Cited, p. 98.

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Map symbol	Soil	Acres	Percent	Map symbol	Soil	Acres	Percent
Ad	Adrian muck, drained	8,900	3.0	MoC3	Miami clay loam, 6 to 12 percent slopes, severely eroded	1,950	0.7
AeA	Alida loam, 0 to 2 percent slopes	3,800	.1	MoD3	Miami clay loam, 12 to 18 percent slopes, severely eroded	456	.2
Am	Alluvial land	975	.3	Mp	Milford silty clay loam	7,400	2.5
Au	Aubbeenaubbee sandy loam	1,750	.6	MrB2	Morley silt loam, 2 to 6 percent slopes, eroded	900	.3
BbA	Blount silt loam, 0 to 2 percent slopes	740	.3	MrC2	Morley silt loam, 6 to 12 percent slopes, eroded	220	.1
Bd	Brady sandy loam	3,100	1.0	MsD3	Morley silty clay loam, 12 to 18 percent slopes, severely eroded	630	.2
BeA	Brems fine sand, 0 to 2 percent slopes	800	.3	OsA	Oshtemo sandy loam, 0 to 2 percent slopes	24,000	8.0
Br	Brookston silty clay loam	22,600	7.5	OsB	Oshtemo sandy loam, 2 to 6 percent slopes	11,700	4.0
ChA	Chelsea fine sand, 0 to 5 percent slopes	4,250	1.5	OsC2	Oshtemo sandy loam, 6 to 12 percent slopes, eroded	5,600	1.9
ChC	Chelsea fine sand, 5 to 10 percent slopes	1,400	.5	OsD	Oshtemo sandy loam, 12 to 18 percent slopes	2,500	.9
CoA	Coupee silt loam, 0 to 2 percent slopes	15,450	5.2	Pa	Palms muck, drained	2,800	1.0
CtA	Crosier loam, 0 to 2 percent slopes	30,200	10.1	Qu	Quinn loam	5,600	1.9
CtB	Crosier loam, 2 to 4 percent slopes	630	.3	Re	Rensselaer loam	12,900	4.4
De	Del Rey silt loam	1,300	.5	Rm	Rensselaer mucky loam	2,550	.9
Ed	Edwards muck	1,500	.5	RtA	Riddles loam, 0 to 2 percent slopes	750	.3
EsA	Elston sandy loam, 0 to 2 percent slopes	1,020	.3	RtB	Riddles loam, 2 to 6 percent slopes	10,100	3.4
FsA	Fox sandy loam, 0 to 2 percent slopes	1,200	.4	RtC2	Riddles loam, 6 to 12 percent slopes, eroded	3,800	1.3
FsB	Fox sandy loam, 2 to 6 percent slopes	1,150	.4	RtD2	Riddles loam, 12 to 18 percent slopes, eroded	1,050	.4
Gf	Gilford sandy loam	7,800	2.5	Te	Tedrow fine sand	300	.1
GP	Gravel pits	1,400	.5	TrA	Tracy sandy loam, 0 to 2 percent slopes	2,200	.7
HdA	Hillsdale sandy loam, 0 to 2 percent slopes	1,350	.4	TrB	Tracy sandy loam, 2 to 6 percent slopes	3,520	1.3
HdB	Hillsdale sandy loam, 2 to 6 percent slopes	3,600	1.2	TrC2	Tracy sandy loam, 6 to 12 percent slopes, eroded	1,450	.5
HeC2	Hillsdale complex, 6 to 12 percent slopes, eroded	4,400	1.5	Tx	Troxel silt loam	1,100	.4
HeD2	Hillsdale complex, 12 to 18 percent slopes, eroded	1,300	.4	TyA	Tyner loamy sand, 0 to 6 percent slopes	35,900	12.0
Hm	Houghton muck	750	.3	TyC	Tyner loamy sand, 6 to 12 percent slopes	4,500	1.5
Ho	Houghton muck, drained	8,800	3.0	TyD	Tyner loamy sand, 12 to 18 percent slopes	1,350	.5
La	Landes loam	1,150	.4	Wk	Wallkill silt loam	920	.3
Ma	Made land	510	.2	Ws	Washtenaw silt loam	1,150	.4
Mc	Marsh	920	.3	Wt	Whitaker loam	4,450	1.5
MeA	Martinsville loam, 0 to 2 percent slopes	530	.2		Water	730	.2
MeB2	Martinsville loam, 2 to 6 percent slopes, eroded	1,800	.6		Total	298,880	100.0
MeC2	Martinsville loam, 6 to 12 percent slopes, eroded	439	.2				
Mf	Maumee loamy fine sand	890	.3				
Mq	Maumee mucky loamy fine sand	7,300	2.5				
MkB	Metea loamy fine sand, 4 to 10 percent slopes	650	.2				
MmB	Miami loam, 2 to 6 percent slopes	1,250	.4				
MmC2	Miami loam, 6 to 12 percent slopes, eroded	800	.3				

Metropolitan growth and urban development have disturbed many soils in St. Joseph County. During construction, much of the land is cut, filled, or reshaped. Sometimes the topsoil is removed and stockpiled to be spread later as the final cover, or the topsoil is removed and sold. In low areas, as much as 3 or 4 feet of fill material covers the original soil. In some places cuts have been made, and the upper part of the soil has been removed.

In this soil survey no attempt has been made to describe the profile of the soil material in built-up areas. These areas have been mapped showing the soil series and phase as it would have been in an undisturbed area. Although the soil descriptions may not coincide exactly with the soil at any given place in the built-up areas, the soil material is similar enough to be considered as the named mapping unit.

Adrian Series

The Adrian series consists of deep, very poorly drained, organic soils that are nearly level and depressional. These soils are mainly on the broad Kankakee muck flats and in depressions on outwash plains. They formed in decomposed organic material over outwash sand. The native vegetation was mainly water-tolerant grass, sedges, and reeds and a few mixed hardwoods.

In a representative profile, the surface layer is black muck about 13 inches thick. The layer below that is dark reddish-brown friable muck 8 inches thick. The underlying material extends to a depth of 60 inches or more. It is white fine sand in the upper 6 inches; light brownish-gray, loose fine sand in the next 8 inches; strong-brown and light brownish-gray sand in the next 7 inches; and mottled, dark-gray sand in the lower 18 inches.

Adrian soils have rapid permeability and a high available water capacity. The organic-matter content is very high. Runoff is very slow or ponded.

Representative profile of Adrian muck, drained, in a cultivated field, 100 feet south and 1,250 feet west of the NE corner of NW¼ sec. 17, T. 37 N., R. 2 E.

Oap—0 to 13 inches, black (N 2/0) sapric material, broken face and rubbed; less than 5 percent fiber, no trace after rubbing; moderate, medium, granular structure; friable; mineral content 30 percent; herbaceous; very strongly acid; abrupt, smooth boundary.

Oa2—13 to 21 inches, dark reddish brown (5YR 3/2) sapric material, broken face, black (5YR 2/1) rubbed; 10 percent fiber, 5 percent rubbed; moderate, medium, granular structure; friable; mineral content 5 percent; herbaceous; strongly acid; abrupt, smooth boundary.

IIC1—21 to 27 inches, white (10YR 8/2) fine sand; single grained; loose; strongly acid; abrupt, smooth boundary.

IIC2—27 to 35 inches, light brownish-gray (10YR 6/2) fine sand; high in iron oxides; single grained; very strongly acid; abrupt, smooth boundary.

IIC3—35 to 42 inches, strong-brown (7.5YR 5/6) and light brownish-gray (10YR 6/2) sand; friable; pockets of gray (5YR 5/1) silt loam and loam and clay loam make up one-third of the volume; medium acid; abrupt, smooth boundary.

IIC4g—42 to 60 inches, dark-gray (10YR 4/1) sand; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; single grained; loose; neutral.

Depth to the IIC horizon ranges from 16 to 50 inches. The organic layers are black (N 2/0, 10YR 2/1, or 5YR 2/1) or dark reddish brown (5YR 3/2).

Adrian soils are associated on the landscape with the very poorly drained Palms and Edwards soils. Adrian soils are underlain by sand, but Palms soils are underlain by loamy material, and Edwards soils are underlain by marl.

Ad—Adrian muck, drained. This soil is in irregularly shaped areas on broad flats and in depressions. The areas range from 2 to 940 acres but average 100 acres.

Included in mapping are areas, less than 2 acres in size, of depressional, very poorly drained Palms, Houghton, and Maumee soils. Small, undrained areas of Adrian muck are shown on the detailed map by a special symbol.

The soil has a seasonal high water table within 1 foot of the surface. Wetness is the major concern in management.

Most areas of this soil are used for special crops and cash-grain farming. If it is adequately drained, the soil is well suited to all crops commonly grown in the county. It has severe limitations for most nonfarm uses. Capability unit IVw-3; woodland group 4w23.

Alida Series

The Alida series consists of deep, somewhat poorly drained, nearly level soils on outwash terraces. These soils are mainly between nearly level, well-drained soils and poorly drained soils in depressions. They formed in loamy outwash and the underlying outwash sand. The native vegetation was mainly mixed hardwoods and prairie grass.

In a representative profile, the surface layer is very dark grayish-brown loam about 9 inches thick. The subsoil is 43 inches thick. It is mottled, dark grayish-brown, friable gravelly loam in the upper 5 inches; mottled, dark yellowish-brown, friable clay loam in the next 9 inches; mottled yellowish-brown, firm clay loam in the next 10 inches; and mottled, gray, friable gravelly loamy sand in the lower 19 inches. The underlying material is gray sand that extends to a depth of 64 inches.

Alida soils have moderate permeability and a moderate available water capacity. The organic-matter content is high in the surface layer. Runoff is slow.

Representative profile of Alida loam, 0 to 2 percent slopes, in a cultivated field, 280 feet east and 1,000 feet south of the NW corner of NE¼ sec. 28, T. 38 N., R. 1 E.

Ap—0 to 9 inches, very dark grayish-brown (10YR 3/2) loam, dark brown (10YR 3/3) crushed; weak, fine, subangular blocky structure parting to weak, moderate, granular; friable; slightly acid; abrupt, smooth boundary.

B1—9 to 14 inches, dark grayish-brown (10YR 4/2) gravelly loam; many, medium, faint, grayish-brown (10YR 5/2) mottles and common, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; weak, medium, subangular blocky structure; friable; many very dark grayish-brown (10YR 3/2) root channel fillings; 20 percent gravel; slightly acid; clear, wavy boundary.

B21t—14 to 23 inches, dark yellowish-brown (10YR 4/4) clay loam; many, medium, distinct, grayish-brown (10YR 5/2) mottles; weak, moderate, subangular blocky structure; friable; 10 percent shale frag-

ments; few, patchy, faint, thin, grayish-brown (2.5Y 5/2) clay films on faces of peds; slightly acid; clear, wavy boundary.

B22t—23 to 33 inches, yellowish-brown (10YR 5/8) clay loam; many, medium, prominent, gray (10YR 6/1) mottles; moderate, medium, subangular blocky structure; firm; common, discontinuous, distinct, thin, grayish-brown (2.5Y 5/2) clay films on faces of peds; strongly acid; clear, wavy boundary.

IIB3—33 to 52 inches, gray (10YR 6/1) gravelly loamy sand; few, medium, prominent, dark yellowish-brown (10YR 4/4) mottles; weak, medium, subangular blocky structure; friable; horizontal band of sandy loam between depths of 50 and 52 inches; 25 percent fine gravel; strongly acid; gradual, wavy boundary.

IIC—52 to 64 inches, gray (10YR 6/1) sand; single grained; loose; strongly acid.

The solum is 40 to 60 inches thick. Depth of contrasting material is 30 to 40 inches. The Ap horizon ranges from very dark grayish brown (10YR 3/2) to very dark brown (10YR 2/2) or very dark gray (10YR 3/1). In some places there is an A2 horizon of grayish-brown (10YR 5/2) or pale-brown (10YR 6/3) loam or sandy loam. The Ap and A2 horizons are slightly acid or neutral. The B horizon contains medium to coarse, faint to prominent mottles that have hue of 7.5YR to 10YR. It is dominantly clay loam or heavy sandy loam but is gravelly loam and gravelly loamy sand in some places. The B horizon is neutral or slightly acid in the upper part and medium acid or strongly acid in the lower part. The C horizon is loamy sand or sand.

In the Alida soils in St. Joseph County, the layer of gravelly loamy sand is at a depth of 33 inches, which is shallower than is defined in the range for the Alida series. This difference does not alter the usefulness and behavior of the soils.

Alida soils are associated on the landscape with the well-drained Coupee soils, and they have drainage characteristics similar to those of the Brady and Quinn soils. Alida soils have gray mottles in the B horizon, but Coupee soils do not. They have a finer textured B horizon than Brady soils and a darker and thicker A horizon than Quinn soils.

AeA—Alida loam, 0 to 2 percent slopes. This soil is in irregularly shaped areas on broad flats. The areas range from 2 to 400 acres but average 50 acres.

Included in mapping are small areas of depressional, very poorly drained Rensselaer soils and nearly level, poorly drained Quinn soils. Also included are small areas of soils that have a surface layer of silt loam or sandy loam.

The soil has a seasonal high water table at a depth of 1 to 3 feet. Wetness is the major concern in management.

Most areas of this soil are used for cash-grain farming, but some are used for grasses and legumes for forage. If it is adequately drained, the soil is well suited to all crops grown in the county, but it has moderate limitations for most nonfarm uses. Capability unit IIw-2; woodland group 3w5.

Alluvial Land

Am—Alluvial land consists of areas of alluvium recently deposited by streams. The areas range from 2 to 40 acres but average 10 acres. Slopes are 0 to 2 percent. The soil material is stratified in thin layers and ranges widely in texture. The surface layer is high in organic-matter content. Most of the soil material is slightly acid in the upper 14 inches and medium acid below that depth.

Included with this land type in mapping are small areas of Landes soils and Gilford sandy loam.

Alluvial land generally is not farmed because of frequent stream overflow and constant change caused by meandering stream channels. Generally, the water table is near the surface throughout the year. Open ditches provide some drainage.

This land type is covered by a dense stand of shrubs and hardwoods of low quality. It has severe limitations for all nonfarm uses. Capability unit Vw-3; not assigned to a woodland group.

Aubbeenaubbee Series

The Aubbeenaubbee series consists of deep, somewhat poorly drained, nearly level soils on uplands. These soils are mainly on broad ground moraines adjacent to low depressions and long drainageways. They formed in sandy loam drift and the underlying loamy glacial till. The native vegetation was mainly mixed hardwoods.

In a representative profile, the surface layer is dark grayish-brown sandy loam about 8 inches thick. The subsurface layer is brown sandy loam 4 inches thick. The subsoil is 48 inches thick. It is mottled, yellowish-brown, friable sandy loam in the upper 9 inches; mottled grayish-brown firm sandy clay loam in the next 5 inches; mottled, grayish-brown, firm clay loam in the next 13 inches; mottled, gray, firm clay loam in the next 15 inches; and mottled, brown, firm light clay loam in the lower 6 inches. The underlying material is mottled, brown loam that extends to a depth of 74 inches.

Aubbeenaubbee soils have moderate permeability and a moderate available water capacity. The organic-matter content is moderate in the surface layer. Runoff is slow.

Representative profile of Aubbeenaubbee sandy loam, in a cultivated field, 300 feet south and 120 feet east of the NW corner of NE¼ sec. 11, T. 36 N., R. 3 E.

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) sandy loam; weak, fine, granular structure; friable; medium acid; abrupt, smooth boundary.

A2—8 to 12 inches, brown (10YR 5/3) sandy loam; common, medium, faint, grayish-brown (10YR 5/2) mottles; weak, fine, granular structure; friable; medium acid; clear, wavy boundary.

B1—12 to 21 inches, yellowish-brown (10YR 5/4) sandy loam; common, medium, distinct, grayish-brown (10YR 5/2) mottles; weak, fine, granular structure; friable; few, discontinuous, distinct, medium, grayish-brown (10YR 5/2) silt coatings on faces of peds; friable; medium acid; clear, wavy boundary.

IIB21t—21 to 26 inches, grayish-brown (10YR 5/2) sandy clay loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium, subangular blocky structure; firm; few, discontinuous, distinct, thin, dark-gray (10YR 4/1) clay films on faces of peds; medium acid; clear, smooth boundary.

IIB22t—26 to 39 inches, grayish-brown (10YR 5/2) clay loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium, subangular blocky structure; firm; few, patchy, faint, thin, gray (10YR 5/1) clay films on faces of peds; neutral; clear, wavy boundary.

IIB23t—39 to 54 inches, gray (5Y 6/1) clay loam; common, medium, distinct, yellowish-brown (10YR 5/6)

mottles; moderate, coarse, subangular blocky structure; firm; few, thin, medium, very dark brown (10YR 2/2) oxide concretions; patchy, distinct, thin, dark-gray (10YR 4/1) clay films in pores and on faces of peds; neutral; clear, smooth boundary.

IIB3—54 to 60 inches, brown (10YR 5/3) light clay loam; few, medium, distinct, yellowish-brown (10YR 5/8) mottles; weak, coarse, subangular blocky structure; firm; few pebbles smaller than 15 millimeters; mildly alkaline; gradual, wavy boundary.

IIC—60 to 74 inches, brown (10YR 5/3) loam; few, medium, distinct, grayish-brown (10YR 5/2) mottles; massive; firm; common pebbles smaller than 15 millimeters; strongly effervescent; moderately alkaline.

The solum is 36 to 60 inches thick. The Ap horizon is dark grayish brown (10YR 4/2) or light brownish gray (10YR 6/2). The A2 horizon is 0 to 6 inches thick, depending on the thickness of the plowed layer. The IIB21t horizon is sandy loam or sandy clay loam, and the IIB22 horizon is clay loam, sandy loam, or sandy clay loam. The IIB3 horizon has few to common, fine to medium, distinct to prominent mottles that have hue of 10YR and 5YR.

Aubbeenaubbee soils are associated on the landscape with the well-drained Metea and Riddles soils and have drainage characteristics similar to those of the Crosier soils. Aubbeenaubbee soils have yellowish-brown mottles in the B horizon, but Metea and Riddles soils do not. They are coarser textured in the upper part of the solum than Crosier soils.

Au—Aubbeenaubbee sandy loam. This soil is in irregularly shaped areas, mainly on broad flats. The areas range from 2 to 50 acres but average 10 acres. Slopes are 0 to 2 percent.

Included in mapping are small areas of somewhat poorly drained Crosier soils and soils that have a surface layer of loamy sand.

The soil has a seasonal high water table at a depth of 1 to 3 feet. Wetness is the major concern in management.

Most areas of this soil are used for cash-grain farming, but some are used for grasses and legumes for forage. If it is adequately drained, the soil is well suited to all crops commonly grown in the county, but it has moderate limitations for most nonfarm uses. Capability unit IIw-11; woodland group 3w5.

Blount Series

The Blount series consists of deep, somewhat poorly drained, nearly level soils on till plains and moraines. These soils are mainly on the broad flats adjacent to gently sloping Morley soils. They formed in silty clay and silty clay loam glacial till. The native vegetation was mixed hardwoods.

In a representative profile, the surface layer is grayish-brown silt loam about 10 inches thick. The subsoil is 24 inches thick. It is mottled, gray, friable silty clay loam in the upper 7 inches and mottled, yellowish-brown, firm silty clay in the lower 17 inches. The underlying material is mottled, grayish-brown silty clay loam that extends to a depth of 60 inches.

Blount soils have slow permeability and a high available water capacity. The organic-matter content is slow in the surface layer. Runoff is slow.

Representative profile of Blount silt loam, 0 to 2 percent slopes, in a cultivated field, 280 feet west and 1,820 feet south of the NE corner of SW¼ sec. 11, T. 38 N., R. 1 W.

Ap—0 to 10 inches, grayish-brown (10YR 5/2) silt loam; moderate, medium, granular structure; friable; medium acid; abrupt, smooth boundary.

B21t—10 to 17 inches, gray (10YR 6/1) silty loam; many, medium, distinct, yellowish-brown (10YR 5/4 and 10YR 5/6) mottles; moderate, medium, prismatic structure parting to moderate, coarse, subangular blocky; friable; gray (10YR 6/1) silt coatings on vertical faces of peds; few, patchy, distinct, thin, grayish-brown (10YR 5/2) clay films on faces of peds and in pores; very strongly acid; gradual, wavy boundary.

B22t—17 to 30 inches, yellowish-brown (10YR 5/4) silty clay; many, medium, distinct, grayish-brown (10YR 5/2) and gray (10YR 6/1) mottles; moderate, medium, prismatic structure parting to moderate, coarse, angular blocky; firm; thin gray (10YR 5/1) clay films on vertical faces of peds; very strongly acid; gradual, wavy boundary.

B3—30 to 34 inches, yellowish-brown (10YR 5/4) silty clay; many, medium, distinct, grayish-brown (10YR 5/2) and gray (10YR 6/1) mottles; weak, coarse, angular blocky structure; firm; few, patchy, distinct, thin, gray (10YR 5/1) clay films on faces of peds; 2 percent fine gravel; few lime nodules; calcareous coatings on horizontal faces of peds; moderately alkaline; gradual, wavy boundary.

C—34 to 60 inches, grayish-brown (10YR 5/2) silty clay loam; few, fine, distinct, dark yellowish-brown (10YR 5/4) mottles; weak, thick, platy structure; firm; 2 percent fine gravel; few, patchy, distinct thin, gray (10YR 5/1) clay films; strongly effervescent; moderately alkaline.

The solum is 20 to 40 inches thick. The Ap horizon is grayish brown (10YR 5/2) or dark grayish brown (10YR 4/2). In some profiles there is an A2 horizon of grayish-brown (10YR 5/2) silt loam.

Blount soils are similar to and are associated on the landscape with the well drained and moderately well drained Morley soils. Unlike Morley soils, Blount soils are mottled.

BbA—Blount silt loam, 0 to 2 percent slopes. This soil is in irregularly shaped areas on broad flats. The areas range from 2 to 160 acres but average 20 acres.

Included in mapping are small areas of well drained and moderately well drained Morley soils and poorly drained Milford soils.

The soil has a seasonal high water table at a depth of 1 to 3 feet. Wetness is the major concern in management.

Most areas of this soil are used for cash-grain farming, but some are planted to grasses and legumes for forage. If it is adequately drained, the soil is well suited to most crops commonly grown in the county, but it has severe limitations for most nonfarm uses. Capability unit IIw-2; woodland group 3w5.

Brady Series

The Brady series consists of deep, somewhat poorly drained, nearly level soils on outwash terraces. These soils are mainly between nearly level, well-drained soils and very poorly drained soils in depressions. They formed in sandy outwash. The native vegetation was mainly mixed hardwoods.

In a representative profile, the surface layer is very dark grayish-brown sandy loam about 8 inches thick. The subsurface layer is light brownish-gray sandy loam 5 inches thick. The subsoil is 37 inches thick. It is mottled, brown, friable sandy loam in the upper 21 inches and yellowish-brown, friable loamy sand in the lower 16 inches. The underlying material is light

brownish-gray sand that extends to a depth of about 60 inches.

Brady soils have moderately rapid permeability and a low available water capacity. The organic-matter content is moderate in the surface layer. Runoff is slow.

Representative profile of Brady sandy loam, in an idle field, 300 feet west and 500 feet north of the SE corner of sec. 29, T. 38 N., R. 4 E.

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) sandy loam; weak, fine, granular structure; friable; strongly acid; abrupt, smooth boundary.

A2—8 to 13 inches, light brownish-gray (10YR 6/2) sandy loam; many, medium, faint, grayish-brown (10YR 5/2) mottles; weak, medium, platy structure parting to weak, fine, granular; very friable; medium acid; clear, smooth boundary.

B21t—13 to 20 inches, brown (10YR 5/3) sandy loam; common, medium, distinct, yellowish-brown (10YR 5/6) and brown (7.5YR 5/4) mottles; moderate, medium, subangular blocky structure; friable; strongly acid; gradual, wavy boundary.

B22t—20 to 34 inches, brown (7.5YR 4/4) sandy loam; common, medium, distinct, yellowish-brown (10YR 5/8) mottles and few, fine, faint, light brownish-gray (10YR 6/2) mottles; moderate, medium, subangular blocky structure; friable; few, faint, thin, discontinuous, yellowish-brown (10YR 5/8) clay films on faces of peds; some bridging of sand grains; very strongly acid; clear, wavy boundary.

B3—34 to 50 inches, yellowish-brown (10YR 5/4) loamy sand; weak, medium, subangular blocky structure; friable; few iron and manganese oxide stains; strongly acid; gradual, wavy boundary.

C—50 to 60 inches, light brownish-gray (10YR 6/2) sand; single grained; loose; slightly acid.

The solum is 48 to 60 inches thick. The Ap horizon is very dark grayish brown (10YR 3/2) or very dark gray (10YR 3/1). In most profiles there is an A2 horizon, which is light brownish gray (10YR 6/2) or grayish brown (10YR 5/2). The Ap and A2 horizons are slightly acid to strongly acid. The B2t horizon contains fine to medium, faint to distinct mottles that have hue of 7.5YR and 10YR. It is sandy loam or heavy loamy sand. The B22t horizon is strongly acid or very strongly acid. The C horizon is loamy sand or sand.

Brady soils are associated on the landscape with the well-drained Oshtemo soils and have drainage characteristics similar to those of the Alida and Tedrow soils. They are similar to Oshtemo soils, but they have mottles in the B horizon and Oshtemo soils do not. Brady soils have a coarser textured B horizon than Alida soils and a finer textured solum than Tedrow soils.

Bd—Brady sandy loam. This soil is in irregularly shaped areas on broad flats. The areas range from 2 to 120 acres but average 40 acres. Slopes are 0 to 2 percent.

Included in mapping are areas, less than 2 acres in size, of depressional, very poorly drained Gilford soils and nearly level to gently sloping, well-drained Oshtemo soils. Also included are small areas of soils that have a surface layer of loamy sand.

This soil has a seasonal water table at a depth of 1 to 3 feet. Wetness is the major concern in management.

Most areas of this soil are used for cash-grain farming, but some are planted to grasses and legumes for forage. The soil is suited to most crops commonly grown in the county, but it has limitations for most nonfarm uses. Capability unit IIIw-4; woodland group 3w20.

Brems Series

The Brems series consists of deep, moderately well drained, nearly level soils on outwash plains. These soils are mainly between gently sloping, well-drained soils and nearly level, somewhat poorly drained soils. They formed in acid outwash sand that has been reworked by wind in some places. The native vegetation was mainly mixed hardwood forest.

In a representative profile, the surface layer is dark grayish-brown fine sand about 8 inches thick. The subsurface layer is brown fine sand 4 inches thick. The subsoil is 36 inches thick. It is mottled, pale-brown, very friable fine sand in the upper 9 inches; mottled, light yellowish-brown, loose fine sand in the next 7 inches; and mottled, light-gray, loose fine sand in the lower 20 inches. The underlying material is light-gray fine sand that extends to a depth of 60 inches.

Brems soils have very rapid permeability and a low available water capacity. The organic-matter content is moderate in the surface layer. Runoff is slow.

Representative profile of Brems fine sand, 0 to 2 percent slopes, in a cultivated field, 200 feet south and 150 feet east of the NW corner of sec. 32, T. 38 N., R. 4 E.

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) fine sand mixed with some dark brown (10YR 4/3); weak, fine, granular structure; very friable; medium acid; abrupt, smooth boundary.

A2—8 to 12 inches, brown (10YR 5/3) fine sand; weak, fine, granular structure; very friable; medium acid; clear, wavy boundary.

B21—12 to 21 inches, pale-brown (10YR 6/3) fine sand; many, medium, faint, yellowish-brown (10YR 5/6) mottles; weak, fine, subangular blocky structure; very friable; very strongly acid; clear, wavy boundary.

B22—21 to 28 inches, light yellowish-brown (10YR 6/4) fine sand; few, fine, distinct, strong-brown (7.5YR 5/8) mottles; single grained; loose; strongly acid; gradual, wavy boundary.

B3—28 to 48 inches, light-gray (10YR 7/2) fine sand; few, fine, prominent, strong-brown (7.5YR 5/8) mottles; single grained; loose; strongly acid; gradual, wavy boundary.

C—48 to 60 inches, light-gray (10YR 7/2) fine sand; single grained; loose; strongly acid.

The solum is 35 to 70 inches thick. The Ap horizon is dark brown (10YR 3/3), brown (10YR 5/3), grayish brown (10YR 5/2), or dark grayish brown (10YR 4/2). The A2 horizon is brown or yellowish-brown fine sand or loamy sand. Both the Ap and A2 horizons are slightly acid to strongly acid.

The B2 horizon is brown (10YR 5/3), strong brown (7.5YR 5/6), yellowish brown (10YR 5/8), light yellowish brown (10YR 6/4), or pale brown (10YR 6/3) and is loamy sand or fine sand. In some profiles the B21 and the B22 horizons are not mottled.

Brems soils are associated on the landscape with the well-drained Tyner soils and the somewhat poorly drained Tedrow soils. They are similar to Tyner soils, but they have mottles in the B horizon and Tyner soils do not. Brems soils have a more acid B2 horizon than Tedrow soils.

BeA—Brems fine sand, 0 to 2 percent slopes. This soil is in irregularly shaped areas on broad flats. The areas range from 2 to 80 acres but average 10 acres.

Included in mapping are areas, less than 2 acres in size, of nearly level and gently sloping Tyner loamy sand. Also included are soils that have a surface layer of loamy fine sand.

This soil has a seasonal high water table at a depth

of 2 to 4 feet. Seasonal wetness is the major concern in management.

This soil is suited to corn and soybeans and to grasses and legumes for forage. The soil has limitations for most nonfarm uses. Capability unit IVs-1; woodland group 3s17.

Brookston Series

The Brookston series consists of deep, very poorly drained soils on till plains. These soils are mainly in depressions on broad flats. They formed in glacial till. The native vegetation was water-tolerant hardwoods and grass.

In a representative profile, the surface layer is very dark gray silty clay loam about 15 inches thick. The subsoil is 31 inches thick. It is mottled, dark-gray, firm clay loam in the upper 8 inches; mottled, gray, firm clay loam in the next 13 inches; and mottled, yellowish-brown, firm clay loam in the lower 10 inches. The underlying material is mottled, brown loam that extends to a depth of 72 inches.

Brookston soils have moderate permeability and a high available water capacity. The organic-matter content is high in the surface layer. Runoff is very slow or ponded.

Representative profile of Brookston silty clay loam, in a cultivated field 1,620 feet east and 50 feet north of the SW corner of sec. 6, T. 36 N., R. 4 E.

Ap—0 to 9 inches, very dark gray (10YR 3/1) silty clay loam; weak, medium, granular structure; friable; slightly acid; abrupt, smooth boundary.

A12—9 to 15 inches, very dark gray (10YR 3/1) silty clay loam; few, fine, distinct, dark yellowish-brown (10YR 4/4) mottles and few, fine, faint, dark-gray (10YR 4/1) mottles; moderate, medium, subangular blocky structure; firm; slightly acid; clear, smooth boundary.

B21tg—15 to 23 inches, dark-gray (10YR 4/1) clay loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles and few, fine, faint, grayish-brown (2.5Y 5/2) mottles; moderate, coarse, subangular blocky structure; firm; common, discontinuous, faint, thin, very dark gray (10YR 3/1) clay films on faces of peds; neutral; gradual, wavy boundary.

B22tg—23 to 36 inches, gray (5Y 5/1) clay loam; common, medium, distinct, light olive-gray (5Y 6/2) mottles and few, medium, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium, subangular blocky structure; firm; common, discontinuous, distinct, thin, dark-gray (10YR 4/1) clay films on faces of peds; neutral; clear, wavy boundary.

B3—36 to 46 inches, yellowish-brown (10YR 5/4) clay loam; many, medium, prominent, gray (5Y 5/1) mottles; weak, coarse, subangular blocky structure; firm; few pebbles about 25 millimeters in size; mildly alkaline; gradual, wavy boundary.

C—46 to 72 inches, brown (10YR 5/3) loam; many, coarse, prominent, gray (5Y 5/1) mottles; massive; friable; few pebbles smaller than 25 millimeters; strongly effervescent; moderately alkaline.

The solum is 30 to 50 inches thick. The Ap and A12 horizons are black (10YR 2/1), very dark gray (10YR 3/1), or very dark grayish brown (10YR 3/2). The A12 horizon has few to many, faint to prominent mottles that have a hue of 10YR and 5Y.

Brookston soils are associated on the landscape with the somewhat poorly drained Crosier soils, the poorly drained Milford soils, and the very poorly drained Rensselaer soils, and they have wetness characteristics similar to those of the Milford and Rensselaer soils. Brookston soils are grayer than Crosier soils. They have a B2 horizon of clay loam, but Milford soils have a B2 horizon of silty clay loam. Brookston soils lack the stratified B3 and C horizons of Rensselaer soils.

Br—Brookston silty clay loam. This soil is in irregularly shaped areas on broad, depressional flats. The areas range from 2 to 1,680 acres but average 80 acres.

Included in mapping are areas, less than 2 acres in size, of poorly drained Milford soils, very poorly drained Rensselaer soils, and nearly level, somewhat poorly drained Crosier soils. Also included are soils that have a surface layer of loam or silt loam.

This soil has a seasonal high water table within 1 foot of the surface. Wetness is the major concern in management.

Most areas of this soil are used for farming. Some are used for special crops. If it is adequately drained, the soil is well suited to continuous cultivated crops, but it has severe limitations for most nonfarm uses. Capability unit IIw-1; woodland group 2w11.

Chelsea Series

The Chelsea series consists of deep, excessively drained, nearly level, gently sloping and moderately sloping soils on outwash plains. These soils are mainly on convex side slopes between nearly level to moderately sloping soils. The native vegetation was mixed hardwoods.

In a representative profile, the surface layer is dark-brown fine sand about 6 inches thick. The subsurface layer is light yellowish-brown fine sand 27 inches thick. The layer below that extends to a depth of 87 inches. It is light yellowish-brown, loose fine sand with bands of dark-brown friable sandy loam, ⅛ inch to 1 inch wide and 1 to 4 inches apart.

Chelsea soils have rapid permeability and low available water capacity. The organic-matter content is moderate in the surface layer. Runoff is slow to medium.

Representative profile of Chelsea fine sand, 5 to 10 percent slopes, in a sparsely wooded area, 1,140 feet east and 640 feet north of the SW corner of sec. 9, T. 38 N., R. 3 E.

Ap—0 to 6 inches, dark-brown (10YR 4/3) fine sand; weak, medium, granular structure; friable; strongly acid; abrupt, smooth boundary.

A2—6 to 33 inches, light yellowish-brown (10YR 6/4) fine sand; single grained; loose; medium acid; clear, wavy boundary.

A&B2—33 to 87 inches, light yellowish-brown (10YR 6/4) fine sand (A part); many yellow (10YR 7/6) sand grains; single grained; loose; bands of dark-brown (7.5YR 4/4) sandy loam (B part), 1 to 4 inches apart and 1/8 to 1 inch thick, decreasing in thickness with depth; weak, medium, subangular blocky structure; friable; strongly acid.

The solum is 4 to 7 feet thick. The Ap horizon is very dark gray (10YR 3/1), very dark grayish brown (10YR 3/2), or dark brown (10YR 4/3). In some profiles there is an A1 horizon, which is very dark gray (10YR 3/1) or dark grayish brown (10YR 4/2). In most profiles there is an A2 horizon, which is medium acid or strongly acid.

The A part of the A&B2 horizon is light yellowish brown (10YR 6/4) or yellowish brown (10YR 5/4). The B bands are brown (10YR 4/3), dark yellowish-brown (10YR 4/4), or dark-brown (7.5YR 4/4) loamy sand or sandy loam. In

some profiles the B bands are 1/4 inch to 2 inches thick, but the total thickness is not more than 6 inches within 60 inches.

Chelsea soils are associated on the landscape with the well-drained Tyner and Oshtemo soils. Chelsea soils are coarser textured than Tyner and Oshtemo soils.

ChA—Chelsea fine sand, 0 to 5 percent slopes. This soil is in irregularly shaped areas on broad flats. The areas range from 2 to 20 acres but average 10 acres. This soil has a profile similar to the one described as representative of the series, but its surface layer is thicker.

Included in mapping are small areas of nearly level and gently sloping Tyner loamy sand.

Droughtiness and soil blowing are the major concerns in management. Wind blows the dry sand particles, which damages crops.

This soil is poorly suited to row crops, grasses, and legumes. It has slight limitations for most nonfarm uses. Capability unit IIIs-1; woodland group 3s17.

ChC—Chelsea fine sand, 5 to 10 percent slopes. This soil is on broad side slopes at a higher elevation than surrounding soils. It is in irregularly shaped areas on outwash plains. The areas range from 2 to 240 acres but average 30 acres. This soil has the profile described as representative of the series.

Included in mapping are small areas of moderately sloping and strongly sloping Tyner loamy sand and gently sloping to moderately sloping Oshtemo sandy loam. Also included are soils that are fine sand throughout and small areas where wind has removed soil material and formed circular depressions called blowouts.

Droughtiness and soil blowing are the major concerns in management. Wind blows the dry sand particles, which damages crops.

This soil is poorly suited to row crops, grasses, and legumes. It has moderate limitations, because of slope, for most nonfarm uses. Capability unit IIIe-12; woodland group 3s17.

Coupee Series

The Coupee series consists of deep, well-drained, nearly level soils on outwash plains. These soils are mainly on broad flats. They formed in loamy outwash and the underlying sandy outwash. The native vegetation was tall prairie grasses.

In a representative profile, the surface layer is black silt loam about 14 inches thick. The subsoil is 38 inches thick. It is brown, friable heavy silt loam in the upper 7 inches; brown, firm light clay loam in the next 5 inches; dark yellowish-brown, firm light clay loam in the next 7 inches; and dark-brown loamy sand and sand in the lower 19 inches. The underlying material is pale-brown, stratified fine sand, sand, and very shaly coarse sand that extends to a depth of 72 inches.

Coupee soils have moderate permeability and a moderate available water capacity. The organic-matter content is high in the surface layer. Runoff is slow.

Representative profile of Coupee silt loam, 0 to 2 percent slopes, in a cultivated field, 300 feet west and 120 feet south of the center of NE¼ sec. 30, T. 38 N., R. 1 E.

Ap—0 to 10 inches, black (10YR 2/1) silt loam; moderate, fine, granular structure; friable; neutral; abrupt, smooth boundary.

A12—10 to 14 inches, black (10YR 2/1) silt loam; moderate, medium, granular structure; friable; medium acid; clear, wavy boundary.

B1—14 to 21 inches, brown (10YR 5/3) heavy silt loam; moderate, medium and fine, subangular blocky structure; friable; very dark grayish-brown (10YR 3/2) organic coatings on faces of most peds; many, very fine, random, inped, continuous pores; discontinuous very dark brown (10YR 2/2) linings in pores and old root channels; strongly acid; clear, wavy boundary.

B21t—21 to 26 inches, brown (10YR 4/3) light clay loam; moderate, medium, subangular blocky structure; firm; thin, discontinuous, dark-brown (10YR 3/3) clay films on faces of peds; common, very fine, random, inped, continuous pores; discontinuous very dark grayish-brown (10YR 3/2) linings in pores and old root zones; few fine pebbles 1/2 inch and less in diameter; medium acid; clear, wavy boundary.

B22t—26 to 33 inches, dark yellowish-brown (10YR 4/4) light clay loam; moderate, coarse and medium, subangular blocky structure; firm; few, fine, random, inped, continuous pores; discontinuous dark-brown (10YR 3/3) linings in pores; thin, discontinuous, brown (10YR 4/3) clay films on faces of peds; few fine pebbles about 1/2 inch in diameter; medium acid; clear, wavy boundary.

IIB3—33 to 52 inches, dark-brown (7.5YR) 4/4) stratified loamy sand and medium to coarse sand; weak, coarse, subangular blocky structure and single grained; very friable and loose; thin, discontinuous, very dark grayish-brown (10YR 3/2) clay films as bridging and as coatings on some sand grains; 10 to 15 percent pebbles 1/2 to 1 inch in diameter; common shale fragments; strongly acid; clear, wavy boundary.

IIC—52 to 72 inches, stratified pale-brown (10YR 6/3) fine sand, sand, and very shaly coarse sand; single grained; loose; 5 percent fine gravel in the fine sand and sand; 50 percent fine shale in the shaly coarse sand; strongly acid.

The solum is 40 to 60 inches thick. Depth to the IIB3 horizon ranges from 30 to 40 inches. The A horizon is black (10YR 2/1), very dark gray (10YR 3/1), or very dark grayish brown (10YR 3/2). The B2t horizon is clay loam or heavy sandy clay loam. It is medium acid or strongly acid. The C horizon ranges from strongly acid to neutral.

Coupee soils are associated on the landscape with the well-drained Tracy and Troxel soils. Coupee soils have a thicker, darker A horizon than Tracy soils. They have a thinner A horizon than Troxel soils.

CoA—Coupee silt loam, 0 to 2 percent slopes. This soil is in irregularly shaped areas on broad flats. The areas range from 20 to 2,100 acres but average 640 acres.

Included in mapping are areas, less than 2 acres in size, of nearly level, well-drained Tracy and Troxel soils. The Tracy soils have a lighter colored surface layer, and the Troxel soils are in slight depressions.

Droughtiness is the major concern in management. The soil is suited to most crops commonly grown in the county and has slight limitations for most nonfarm uses. Capability unit IIs-2; woodland group o23.

Crosier Series

The Crosier series consists of deep, somewhat poorly drained, nearly level to gently sloping soils on uplands. These soils are mainly on broad till plains adjacent to low depressions and along drainageways. They formed

in loamy, calcareous glacial till. The native vegetation was mainly mixed hardwoods.

In a representative profile, the surface layer is dark grayish-brown loam about 8 inches thick. The subsurface layer is mottled, grayish-brown loam 3 inches thick. The subsoil is 27 inches thick. It is mottled, grayish-brown, firm clay loam in the upper 9 inches; mottled, brown, firm light clay loam in the next 10 inches; and mottled, brown, friable loam in the lower 8 inches. The underlying material is mottled, brown loam that extends to a depth of 60 inches.

Crosier soils have moderately slow permeability and a high available water capacity. The organic-matter content is moderate in the surface layer. Runoff is slow or medium.

Representative profile of Crosier loam, 0 to 2 percent slopes, in a cultivated field, 280 feet south and 560 feet east of the NW corner of sec. 11, T. 36 N., R. 3 E.

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) loam; weak, fine, granular structure; friable; neutral; abrupt, smooth boundary.

A2—8 to 11 inches, grayish-brown (10YR 5/2) loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, medium, subangular blocky structure; friable; light-gray (10YR 7/1) silt coatings on all faces of peds; slightly acid; clear, smooth boundary.

B21t—11 to 20 inches, grayish-brown (10YR 5/2) clay loam; many, coarse, distinct, yellowish-brown (10YR 5/8) mottles; moderate, medium, subangular blocky structure; firm; dark-gray (10YR 4/1) clay films on faces of all peds; slightly acid; gradual, wavy boundary.

B22t—20 to 30 inches, brown (10YR 5/3) light clay loam; many, medium, faint, grayish-brown (10YR 5/2) mottles and common, medium, distinct, yellowish-brown (10YR 5/6) mottles; moderate, coarse, subangular blocky structure; firm; thin dark-gray (10YR 4/1) clay films on faces of all peds; few pebbles 1 inch and less in diameter; neutral; gradual, wavy boundary.

B3—30 to 38 inches, brown (10YR 5/3) loam; common, medium, faint, yellowish-brown (10YR 5/6) mottles; moderate, coarse, subangular blocky structure; friable; thin gray (10YR 6/1) carbonate and silt coatings on faces of some peds; few, discontinuous, distinct, thin, dark-gray (10YR 4/1) clay films on faces of peds and in pores; strongly effervescent; moderately alkaline.

C—38 to 60 inches, brown (10YR 5/3) loam; few, medium, faint, yellowish-brown (10YR 5/6) mottles; massive; friable to firm; few gray (10YR 6/1) streaks; strongly effervescent; moderately alkaline.

The solum is 24 to 40 inches thick. The Ap horizon is dark gray (10YR 4/1), dark grayish brown (10YR 4/2), or grayish brown (10YR 5/2). The A2 horizon is 0 to 6 inches thick, depending on the thickness of the plowed layer. It is grayish brown (10YR 5/2) or light brownish gray (10YR 6/2). The B2 horizon is clay loam, light clay loam, or heavy loam. It has common to many, faint to distinct mottles that have a hue of 10YR to 2.5Y. The C horizon is loam or heavy sandy loam calcareous till.

Crosier soils are associated on the landscape with the well-drained Riddles and Miami soils and have drainage characteristics similar to those of the Whitaker and Del Rey soils. They formed in the same kind of material as Riddles and Miami soils, but they have mottles in shades of gray in the B horizon. Crosier soils have less clay in the B2 horizon than Del Rey soils and lack the stratified silt and sand that underlies Whitaker soils.

CtA—Crosier loam, 0 to 2 percent slopes. This soil is in irregularly shaped areas on broad flats. The areas range from 2 to 500 acres but average 60 acres. This soil has the profile described as representative of the series.

Included in mapping are areas, less than 2 acres in size, of very poorly drained Brookston soils, poorly drained Milford soils, and gently sloping Crosier soils.

This soil has a seasonal high water table at a depth of 1 to 3 feet. Wetness is the major concern in management.

Most areas of this soil are used for cash-grain farming, but some are used for grasses and legumes for forage. The soil is well suited to continuous cultivated crops (fig. 8), but it has limitations for most nonfarm uses. Capability unit IIw-2; woodland group 3w5.

Figure 8.—Soybeans on Crosier loam, 0 to 2 percent slopes.

CtB—Crosier loam, 2 to 4 percent slopes. This soil is along meandering drainageways, or it surrounds poorly drained and very poorly drained soils in depressions. Slopes are generally uniform, but along lateral drainageways they are more irregularly shaped and shorter. The areas range from 2 to 25 acres but average 8 acres. This soil has a profile similar to the one described as representative of the series, but its surface layer is thinner, it is shallower to the underlying till, and more grayish-brown clay loam has been mixed with the loam plow layer.

Included in mapping are small areas where slopes are 4 to 6 percent.

The hazard of erosion is moderate. Wetness and erosion are major concerns in management.

Most areas of this soil are used for cash-grain farming, but some are used for permanent pasture. If it is adequately drained and erosion is controlled, the soil is suited to cultivated crops, but it has limitations for most nonfarm uses. Capability unit IIw-2; woodland group 3w5.

Del Rey Series

The Del Rey series consists of deep, somewhat poorly drained, nearly level soils on lake plains. These soils are mainly adjacent to low depressions and drainageways. They formed in moderately fine textured lacustrine deposits. The native vegetation was mixed hardwoods.

In a representative profile, the surface layer is dark grayish-brown silt loam about 9 inches thick. The subsoil is 33 inches thick. It is mottled, grayish-brown firm silty clay loam in the upper 4 inches; mottled, grayish-brown, firm silty clay in the next 11 inches; mottled, yellowish-brown, firm silty clay in the next 12 inches; and mottled, pale-brown, friable loam in the lower 6 inches. The underlying material is mottled, yellowish-brown, slightly firm silt loam in the upper 6 inches. Below that it is mottled, dark-brown and pale-brown silty clay loam and silt loam that extends to a depth of 72 inches.

Del Rey soils have slow permeability and a high available water capacity. The organic-matter content is low in the surface layer. Runoff is slow or very slow.

Representative profile of Del Rey silt loam, in a cultivated field; 100 feet east and 360 feet north of the center of NE¼ sec. 18, T. 36 N., R. 3 E.

Ap—0 to 9 inches, dark grayish-brown (10YR 4/2) silt loam; common, medium, distinct, grayish-brown (10YR 5/2) mottles; weak, fine, granular structure; friable; many worm casts; slightly acid; abrupt, smooth boundary.

B21—9 to 13 inches, grayish-brown (10YR 5/2) silty clay loam; many, medium, faint, yellowish-brown (10YR 5/4) mottles; moderate, fine, subangular blocky structure; firm; clay films on some faces of peds; medium acid; clear, wavy boundary.

B22t—13 to 24 inches, grayish-brown (10YR 5/2) silty clay; many, coarse, distinct, dark yellowish-brown (10YR 4/4) and yellowish-brown (10YR 5/6) mottles; moderate, coarse, prismatic structure; firm; thick, continuous, light brownish-gray (10YR 6/2) silt coatings on all vertical faces of peds; continuous clay coatings on horizontal faces of peds; few black (10YR 2/1) concretions (iron and manganese oxides); medium acid; gradual, wavy boundary.

B23t—24 to 36 inches, yellowish-brown (10YR 5/4) silty clay; many, coarse, distinct, grayish-brown (10YR 5/2) mottles; moderate, medium, subangular blocky structure; firm; continuous clay coatings on all faces of peds; slightly acid; gradual, wavy boundary.

B3—36 to 42 inches, pale-brown (10YR 6/3) loam; many, coarse, distinct, brownish-yellow (10YR 6/8) mottles; weak, fine, subangular blocky structure; friable; continuous clay films on all faces of peds; neutral; gradual, wavy boundary.

C1—42 to 48 inches, grayish-brown (10YR 5/2) silt loam, yellowish-brown (10YR 5/4) crushed; many, coarse, distinct, brownish-yellow (10YR 6/6) mottles; weak, coarse, subangular blocky structure; firm; slightly acid; clear, wavy boundary.

C2—48 to 72 inches, stratified dark-brown (10YR 4/3) and pale-brown (10YR 6/3) silty clay loam and silt loam; common, medium, distinct, gray (10YR 6/1) mottles; massive; firm; moderately alkaline; calcareous; gradual, wavy boundary.

The solum is 24 to 48 inches thick. The Ap horizon is very dark gray (10YR 3/1), dark grayish brown (10YR 4/2), or dark gray (10YR 4/1). In some profiles, there is an A2 horizon, which is light brownish gray (10YR 6/2) or grayish brown (10YR 5/2) and is slightly acid or neutral. The B2 horizon has many to few mottles. The B2t horizon is silty clay loam or silty clay.

Del Rey soils are associated on the landscape with the somewhat poorly drained Crosier and Whitaker soils and the poorly drained Milford soils. Del Rey soils have more clay in the B2 horizon than Crosier soils and lack the stratified silt and sand that underlies Whitaker soils. Del Rey soils are not so gray as Milford soils.

De—Del Rey silt loam. This soil is in irregularly shaped areas on broad flats. The areas range from 2 to 80 acres but average 20 acres. Slopes are 0 to 2 percent.

Included in mapping are areas, less than 2 acres in size, of poorly drained Milford soils, very poorly drained Brookston soils, and well-drained, gently sloping soils.

This soil has a seasonal high water table at a depth of 1 to 3 feet. Wetness is the major concern in management.

Most areas of this soil are used for cash-grain farming, but some are used for grasses and legumes for forage. The soil is well suited to farming if it is adequately drained, but it has moderate to severe limitations for most nonfarm uses. Capability unit IIw–2; woodland group 3w5.

Edwards Series

The Edwards series consists of very poorly drained, nearly level and depressional, organic soils that are moderately deep over marl. These soils are mainly on the broad Kankakee muck flats and in pockets of organic material on outwash plains. The native vegetation was mainly water-tolerant grass and hardwoods and sedges and reeds.

In a representative profile, the surface layer is black muck about 12 inches thick. The layer below that is dark reddish-brown, friable muck 18 inches thick. The underlying material is light-gray, calcareous marl that extends to a depth of 52 inches.

Edwards soils have moderate permeability and a high available water capacity. The organic-matter content is very high. Runoff is very slow or ponded.

Representative profile of Edwards muck, in a cultivated field, 100 feet north and 750 feet west of the center of SE¼ sec. 25, T. 37 N., R. 1 E.

Oap—0 to 12 inches, sapric material, black (N 2/0) broken and rubbed; less than 5 percent fiber, no trace after rubbing; moderate, fine, granular structure; friable; mineral content 5 percent; medium acid; abrupt, smooth boundary.

Oa2—12 to 30 inches, sapric material, dark reddish brown (5YR 2/2) sapric material, broken face and rubbed; 20 percent fiber, 10 percent after rubbing; moderate, medium, granular structure; friable; mineral content less than 5 percent; herbaceous; strongly acid; abrupt, wavy boundary.

Lca—30 to 52 inches, light-gray (10YR 7/1) marl; massive; friable; moderately alkaline; violently effervescent.

Depth to the Lca horizon ranges from 16 to 40 inches. The organic layers are black (N 2/0 or 10YR 2/1) to dark reddish brown (5YR 3/2 or 5YR 2/2).

Edwards soils are associated on the landscape with the very poorly drained Palms and Adrian mucks. Edwards soils are underlain by marl, but Palm soils are underlain by loamy material, and Adrian soils are underlain by sand.

Ed—Edwards muck. This soil is in irregularly shaped areas on broad flats and in depressions. The areas range from 2 to 280 acres but average about 25 acres. Slopes are 0 to 2 percent.

Included in mapping are areas, less than 2 acres in size, of very poorly drained Palms and Houghton soils and areas where the marl is exposed at the surface. Also included are wet spots, which are shown on the detailed soil map by a spot symbol.

The soil has a seasonal high water table within 1 foot of the surface. Wetness is the major concern in management.

Most areas of this soil are used for special crops and cash-grain farming. The soil is well suited to all crops commonly grown in the county if it is adequately drained, but it has severe limitations for most nonfarm uses. Capability unit IVw-3; woodland group 4w23.

Elston Series

The Elston series consists of deep, well-drained, nearly level soils on outwash terraces and plains. These soils are mainly in slight depressions between nearly level, well-drained soils. They formed in loamy glacial outwash. The native vegetation was mainly grass.

In a representative profile, the surface layer is very dark brown and very dark grayish-brown sandy loam about 13 inches thick. The subsoil is 37 inches thick. It is brown, firm gravelly sandy clay loam in the upper 5 inches; brown, firm gravelly sandy loam in the next 6 inches; and dark yellowish-brown, loose loamy sand in the lower 26 inches. The underlying material is brown, stratified sand and gravelly sand that extends to a depth of 60 inches.

Elston soils have moderately rapid permeability and a moderate available water capacity. The organic-matter content is high in the surface layer. Runoff is slow.

Representative profile of Elston sandy loam, 0 to 2 percent slopes, in a cultivated field, 1,020 feet south and 150 feet west of the NE corner of SW¼ sec. 8, T. 37 N., R. 4 E.

Ap—0 to 10 inches, very dark brown (10YR 2/2) sandy loam; moderate, coarse, granular structure; friable; many fine roots; slightly acid; abrupt smooth boundary.

A12—10 to 13 inches, very dark grayish-brown (10YR 3/2) sandy loam; weak, medium, subangular blocky structure; friable; many fine roots; slightly acid; clear, smooth boundary.

B21t—13 to 18 inches, brown (7.5YR 4/4) gravelly sandy clay loam; moderate, medium, subangular blocky structure; firm; few fine roots; very dark grayish-brown (10YR 3/2) organic coatings around pebbles; clay bridging of sand grains; medium acid; clear, wavy boundary.

B22t—18 to 24 inches, brown (7.5YR 4/4) gravelly sandy loam; moderate, medium, subangular blocky structure; firm; few fine roots; few, fine, faint, dark-brown (7.5YR 3/2) streaks; neutral; clear, wavy boundary.

B3—24 to 50 inches, dark yellowish-brown (10YR 4/4) loamy sand; single grained; loose; 15 percent fine gravel; neutral; clear, wavy boundary.

C—50 to 60 inches, brown (10YR 5/3) stratified sand and gravelly sand; single grained; loose; strongly effervescent; moderately alkaline.

The solum is 40 to 60 inches thick. The A horizon is black (10YR 2/1), very dark gray (10YR 3/1), or very dark brown (10YR 2/2). The B horizon is dominantly medium acid, but it ranges from neutral to strongly acid. The B2t horizon is typically loam or sandy loam, but it ranges to sandy clay loam, loamy sand, or gravelly sandy clay loam. The C horizon is sand or gravelly sand or stratified sand and gravelly sand. It ranges from medium acid to moderately alkaline in the upper part but is moderately alkaline in the lower part.

Elston soils are associated on the landscape with the well-drained Oshtemo and Fox soils. Elston soils have a darker colored A horizon than Oshtemo and Fox soils.

EsA—Elston sandy loam, 0 to 2 percent slopes. This soil is on broad flats. One area covers 400 acres, but the other areas average only 10 acres.

Included in mapping are small areas of nearly level, well-drained Fox and Oshtemo soils.

Droughtiness is the major concern in management.

This soil is suited to all crops commonly grown in the county and to grasses and legumes for forage. It has slight limitations for most nonfarm uses. Capability unit IIIs-2; woodland group o23.

Fox Series

The Fox series consists of well-drained, nearly level to gently sloping soils that are moderately deep to gravel and sand. These soils formed in loamy outwash and the underlying sand and gravelly sand. They are on terraces and outwash plains, mainly on broad flats and sloping ridges. The native vegetation on these soils was mixed hardwoods.

In a representative profile, the surface layer is dark-brown sandy loam about 8 inches thick. The subsurface layer is brown gravelly sandy loam 4 inches thick. The subsoil is 26 inches thick. It is dark-brown, firm gravelly sandy clay loam in the upper 8 inches; strong-brown, friable sandy loam in the next 6 inches; and dark-brown, firm gravelly clay loam in the lower 12 inches. The underlying material is yellowish-brown, weakly stratified sand and gravelly sand that extends to a depth of 60 inches.

Fox soils have moderate permeability and a moderate available water capacity. The organic-matter content is moderate in the surface layer. Runoff is slow to medium.

Representative profile of Fox sandy loam, 2 to 6 percent slopes, in a gravel pit, 600 feet north and 1,270 feet east of the SW corner of sec. 3, T. 37 N., R. 1 E.

Ap—0 to 8 inches, dark-brown (10YR 4/3) sandy loam; weak, medium, granular structure; friable; medium acid; abrupt, smooth boundary.

A2—8 to 12 inches, brown (10YR 5/3) gravelly sandy loam; weak, medium, granular structure; friable; 20 percent gravel; neutral; clear, wavy boundary.

B21t—12 to 20 inches, dark-brown (7.5YR 4/4) gravelly sandy clay loam; moderate, medium, subangular blocky structure; firm; common, discontinuous, distinct, thin, very dark grayish-brown (10YR 3/2) clay films on horizontal and vertical faces of peds; slightly acid; clear, wavy boundary.

B22t—20 to 26 inches, strong-brown (7.5YR 5/6) sandy loam; weak, fine, subangular blocky structure; friable; clay bridging of sand grains; neutral; clear, wavy boundary.

IIB3t—26 to 38 inches, dark-brown (7.5YR 4/4) gravelly clay loam; weak, medium, subangular blocky structure; firm; few, discontinuous, distinct, thin, dark-brown (7.5YR 3/2) clay films on faces of peds; mildly alkaline; abrupt, irregular boundary.

IIC—38 to 60 inches, weakly stratified yellowish-brown (10YR 5/4) sand and gravelly sand; single grained; loose; calcareous; moderately alkaline.

The solum is 24 to 40 inches thick. The Ap horizon has a hue of 10YR, value of 4 or 5, and chroma of 2 or 3. It is sandy loam or loam and is medium acid. The B21t and

B22t horizons are gravelly sandy clay loam, gravelly sandy loam, or sandy loam. The IIB3t horizon is gravelly clay loam or gravelly sandy clay loam.

Fox soils are associated on the landscape with the well-drained Oshtemo and Elston soils. Fox soils are not so deep to the underlying sand and gravelly sand as Osthemo and Elston soils.

FsA—Fox sandy loam, 0 to 2 percent slopes. This soil is in irregularly shaped areas on broad flats. The areas range from 5 to 240 acres but average 60 acres. This soil has a profile similar to the one described as representative of the series, but its surface layer is thicker in most places.

Included in mapping are areas, less than 2 acres in size, of nearly level, well-drained Oshtemo soils, soils that are similar to this Fox soil but have a lower clay content in the subsoil, and nearly level, well-drained Elston soils.

Droughtiness is the major concern in management.

Most areas of this soil are used for cash-grain farming. The soil is suited to most crops commonly grown in the county and has slight limitations for most nonfarm uses. Capability unit IIs-1; woodland group 1r2.

FsB—Fox sandy loam, 2 to 6 percent slopes. This soil is in irregularly shaped areas on broad flats at a higher elevation than surrounding soils. The areas range from 2 to 50 acres but average 10 acres. This soil has the profile described as representative of the series.

Included in mapping are areas, less than 2 acres in size, of gently sloping Oshtemo and Tyner soils.

Droughtiness is the major concern in management.

Most areas of this soil are used for cash-grain farming or for urban development. The soil is suited to most crops commonly grown in the county and has slight limitations for most nonfarm uses. Capability unit IIIe-9; woodland group 1r2.

Gilford Series

The Gilford series consists of deep, very poorly drained, nearly level and depressional soils on outwash plains. These soils are mainly on broad flats and along major streams. They formed in sandy material that was deposited as glacial outwash, lacustrine sediment, or stream alluvium. The native vegetation was mainly marsh grasses, reeds, sedges, and water-tolerant trees.

In a representative profile, the surface layer is sandy loam about 14 inches thick. It is black in the upper part and very dark gray in the lower part. The subsoil is 24 inches thick. It is mottled, gray, friable sandy loam in the upper 6 inches; mottled, gray, firm heavy sandy loam in the next 12 inches; and mottled, gray, very friable loamy sand in the lower 6 inches. The underlying material is gray sand that extends to a depth of 60 inches.

Gilford soils have moderately rapid permeability and a moderate available water capacity. The organic-matter content is high in the surface layer. Runoff is very slow or ponded.

Representative profile of Gilford sandy loam, in a cultivated field, 50 feet north and 1,900 feet west of the SE corner of sec. 24, T. 38 N., R. 3 E.

Ap—0 to 11 inches, black (10YR 2/1) sandy loam; moderate, fine, granular structure; friable; slightly acid; abrupt, smooth boundary.

A12—11 to 14 inches, very dark gray (10YR 3/1) sandy loam; weak, fine, subangular blocky structure; friable; slightly acid; gradual, wavy boundary.

B21g—14 to 20 inches, gray (10YR 5/1) sandy loam; common, fine, distinct, yellowish-brown (10YR 5/6) mottles; weak, medium, subangular blocky structure; friable; medium acid; clear, irregular boundary.

B22g—20 to 32 inches, gray (10YR 5/1) heavy sandy loam; common, fine, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium, subangular blocky structure; firm; slightly acid; clear, wavy boundary.

B3g—32 to 38 inches, gray (10YR 6/1) loamy sand; common, medium, distinct, strong-brown (7.5YR 5/6) mottles; weak, fine, subangular blocky structure; very friable; neutral; clear, wavy boundary.

IIC1g—38 to 48 inches, gray (10YR 6/1) sand; single grained; loose; neutral; clear, wavy boundary.

IIC2g—48 to 60 inches, gray (10YR 6/1) coarse sand; single grained; loose; strongly effervescent; moderately alkaline.

The solum is 26 to 40 inches thick. The Ap or A1 horizon is black (10YR 2/1), very dark grayish brown (10YR 3/2), very dark brown (10YR 2/2), or very dark gray (10YR 3/1). The B2 horizon is sandy loam, heavy sandy loam, or light sandy clay loam and ranges from medium acid to neutral. The C horizon is dominantly medium and coarse sand, but it is gravelly sand and loamy sand in some places. It ranges from neutral to moderately alkaline.

Gilford soils are associated on the landscape with the somewhat poorly drained Brady soils and have drainage characteristics similar to those of the Rensselaer and Maumee soils. Gilford soils have a grayer solum than Brady soils. They have a coarser textured solum than Rensselaer soils and a finer textured solum than Maumee soils.

Gf—Gilford sandy loam. This soil is in irregularly shaped areas on broad, depressional flats. The areas range from 2 to 1,000 acres, but average 40 acres.

Included in mapping are areas, less than 2 acres in size, of nearly level, somewhat poorly drained Brady soils and depressional, very poorly drained Rensselaer soils. Also included are small areas of soils that have a surface layer of fine sandy loam.

This soil has a seasonal high water table within 1 foot of the surface. Wetness is the major concern in management.

Most areas of this soil are used for cash-grain farming. Some are used for special crops. If it is adequately drained, the soil is well suited to most crops commonly grown in the county, but it has severe limitations for most nonfarm uses. Capability unit IIw-4; woodland group 4w21.

Gravel Pits

GP—Gravel pits are widely distributed throughout the county. They are on eskers and outwash plains, generally in soils of the Fox, Oshtemo, and Tracy series. Areas of this mapping unit range from 5 to 250 acres but average 10 acres. The deposits of stratified sand and gravelly sand in the pits range from 10 to 60 feet in thickness.

Permanent pools of water are in some abandoned pits. Reeds and sedges grow at the edge of some pools and are occasionally used by wildlife. Some abandoned pits are filled with discarded building material, and others are used as dumps for refuse and debris. Not assigned to a capability unit or a woodland group.

Hillsdale Series

The Hillsdale series consists of deep, well-drained, nearly level to strongly sloping soils on till plains and moraines. These soils are mainly between soils that formed in glacial till and those that formed in outwash. They formed in sandy loam glacial till. The native vegetation was mixed hardwoods.

In a representative profile, the surface layer is dark grayish-brown sandy loam about 8 inches thick. The subsurface layer is brown sandy loam 4 inches thick. The subsoil is 51 inches thick. It is dark-brown, firm sandy clay loam in the upper 12 inches; dark-brown, firm heavy sandy loam in the next 9 inches; yellowish-brown, friable sandy loam in the next 6 inches; yellowish-brown, friable light sandy loam in the next 13 inches; and friable loamy sand in the lower 11 inches. The underlying material is yellowish-brown sandy loam that extends to a depth of 72 inches.

Hillsdale soils have moderate permeability and a moderate available water capacity. The organic-matter content is moderate in the surface layer. Runoff is slow to rapid.

Representative profile of Hillsdale sandy loam, 2 to 6 percent slopes, in a cultivated field, 345 feet south and 1,340 feet west of the NE corner of SW¼ sec. 10, T. 36 N., R. 2 E.

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) sandy loam; weak, fine, granular structure; friable; medium acid; abrupt, smooth boundary.

A2—8 to 12 inches, brown (10YR 5/3) sandy loam; moderate, fine, subangular blocky structure; friable; medium acid; clear, smooth boundary.

B21t—12 to 24 inches, dark-brown (7.5YR 4/4) sandy clay loam; moderate, medium, subangular blocky structure; firm; thin clay films on all faces of peds; few pebbles ½ to 1 inch in diameter throughout horizon; slightly acid; gradual, smooth boundary.

B22t—24 to 33 inches, dark-brown (7.5YR 4/4) heavy sandy loam; moderate, medium, subangular blocky structure; firm; common thin clay films; slightly acid; gradual, smooth boundary.

B23t—33 to 39 inches, yellowish-brown (10YR 5/4) sandy loam; weak, medium, subangular blocky structure; friable; clay bridgings on sand grains; few pebbles 1 to 3 inches in diameter; slightly acid; gradual, wavy boundary.

B31—39 to 52 inches, yellowish-brown (10YR 5/4) light sandy loam; weak, fine, subangular blocky structure; friable; medium acid; gradual, wavy boundary.

B32—52 to 63 inches, yellowish-brown (10YR 5/4) stratified loamy sand and silt loam; massive; friable; slightly acid; gradual, wavy boundary.

C—63 to 72 inches, yellowish-brown (10YR 5/4) sandy loam; massive; very friable; neutral.

The solum is 42 to 72 inches thick. The Ap horizon is dark grayish brown (10YR 4/2), grayish brown (10YR 5/2), or brown (10YR 5/3). The Bt horizon is sandy clay loam or sandy loam. The C horizon is sandy loam or stratified sandy loam and loamy sand that has some pockets of sand. It is neutral or mildly alkaline.

Hillsdale soils are associated on the landscape with the well-drained Riddles and Oshtemo soils. Hillsdale soils have a coarser textured B horizon than Riddles soils. Unlike Oshtemo soils, they are not underlain by stratified sand and gravelly sand.

HdA—Hillsdale sandy loam, 0 to 2 percent slopes. This soil is in irregularly shaped areas on broad flats. The areas range from 2 to 40 acres but average 10 acres. This soil has a profile similar to the one described as representative of the series, but its surface layer is thicker in some places.

Included in mapping are areas of some soils that have a surface layer of loam. Also included are small areas of nearly level, well-drained Oshtemo and Riddles soils.

Droughtiness is the major concern in management.

Most areas of this soil are used for cash-grain farming. The soil is suited to most crops commonly grown in the county and has slight limitations for most nonfarm uses. Capability unit IIs-5; woodland group 1r2.

HdB—Hillsdale sandy loam, 2 to 6 percent slopes. This soil is in irregularly shaped areas on knolls and gently rolling side slopes. The areas range from 2 to 100 acres but average 20 acres. This soil has the profile described as representative of the series.

Included in mapping are small areas of gently sloping, well-drained Riddles soils and well-drained Oshtemo soils.

Droughtiness and erosion are the major concerns in management.

Most areas of this soil are cultivated. The soil is suited to most crops commonly grown in the county and has slight limitations for most nonfarm uses. Capability unit IIe-11; woodland group 1r2.

HeC2—Hillsdale complex, 6 to 12 percent slopes, eroded. The complex is in elongated areas on short side slopes and knolls. The areas range from 2 to 60 acres but average 10 acres.

Hillsdale soil makes up about 60 percent of the complex. It has a profile similar to the one described as representative of the series, but its surface layer is thinner and some of the dark-brown sandy clay loam subsoil is mixed with it. Other soils in the complex are Oshtemo sandy loam, Riddles loam, Miami loam, and Miami clay loam.

Included in mapping are moderately steep and moderately sloping soils, severely eroded soils, and soils that are not eroded.

Droughtiness and erosion are the major concerns in management.

Most areas are in permanent pasture, but the complex is suited to most crops commonly grown in the county where erosion is adequately controlled. Because of slope, it has moderate limitations for most nonfarm uses. Capability unit IIIe-15; woodland group 1r2.

HeD2—Hillsdale complex, 12 to 18 percent slopes, eroded. This complex is on short knolls and elongated side slopes. The areas range from 2 to 40 acres but average 10 acres.

Hillsdale soil makes up about 50 percent of the complex. It has a profile similar to the one described as representative of the series, but its surface layer is thinner and some of the dark-brown sandy clay loam subsoil is mixed with it. Other soils in the complex are Oshtemo sandy loam, Riddles loam, Miami loam, and Miami clay loam.

Included in mapping are moderately steep and moderately sloping soils, severely eroded soils, and soils that are not eroded.

Erosion is the major concern in management.

Most areas of this complex are in permanent pasture

or woodland. The complex is poorly suited to cultivated crops. Because of slope, it has severe limitations for most nonfarm uses. Capability unit IVe-15; woodland group 1r2.

Houghton Series

The Houghton series consists of deep, very poorly drained, organic soils that are nearly level or depressional. These soils are mainly on the broad Kankakee muck flats and in depressions on till plains. They formed in mixed organic material on lake plains, outwash plains, and till plains. The native vegetation was mainly sedges, reeds, and water-tolerant grasses and mixed hardwoods.

In a representative profile, the surface layer is black muck about 9 inches thick. The next layer is black muck 7 inches thick. The layer below that is dark reddish-brown, friable muck 38 inches thick. The underlying material is gray medium and fine sand that extends to a depth of 60 inches.

Houghton soils have rapid permeability and a high available water capacity. The organic-matter content is very high in the upper 54 inches. Runoff is very slow or ponded.

Representative profile of Houghton muck, drained, in a cultivated field, 1,600 feet south and 100 feet east of the NW corner of sec. 36, T. 37 N., R. 1 E.

Oap—0 to 9 inches, black (N 2/0) sapric material, broken face, rubbed, and pressed; about 5 percent fiber, trace rubbed; moderate, medium, granular structure; friable; herbaceous fibers; mineral content less than 5 percent; very strongly acid; abrupt, smooth boundary.

Oa2—9 to 16 inches, black (5Y 2/1) sapric material, broken face, rubbed, and pressed; 55 to 65 percent fiber, 10 to 15 percent rubbed; moderate, thick, platy structure; friable; herbaceous; mineral content less than 5 percent; very strongly acid.

Oa3—16 to 23 inches, dark reddish brown (5YR 2/2) sapric material, broken face and rubbed; 60 percent fiber, 10 to 15 percent rubbed; moderate, thick, platy structure; friable; herbaceous; 10 percent fragments; mineral content less than 5 percent; very strongly acid.

Oa4—23 to 33 inches, dark reddish brown (5YR 2/2) sapric material, broken face, rubbed, and pressed; 60 percent fiber, 5 to 10 percent rubbed; weak, thick, platy structure; friable; herbaceous; less than 5 percent coarse fragments; mineral content less than 5 percent; strongly acid; gradual, wavy boundary.

Oa5—33 to 38 inches, dark reddish brown (5YR 2/2) sapric material, broken face and rubbed; 80 percent fiber, 10 to 15 percent rubbed; weak, thick, platy structure; friable; herbaceous; 15 percent coarse fragments 1/2 inch to 2 inches in diameter; mineral content 5 percent; strongly acid.

Oa6—38 to 54 inches, dark reddish brown (5YR 2/2) sapric material, broken face, rubbed, and pressed; 35 to 45 percent fiber rubbed; weak, thick, platy structure; friable; herbaceous; 5 percent coarse fragments; mineral content 25 percent; slightly acid; clear, wavy boundary.

IIC—54 to 60 inches, gray (10YR 6/1) medium and fine sand; single grained; loose; slightly acid.

The organic layers are more than 51 inches thick. The IIC horizon ranges from sand to clay loam.

Houghton soils are associated on the landscape with the very poorly drained Palms, Adrian, and Wallkill soils. Houghton soils have more than 51 inches of organic material over mineral soil, but Palms and Adrian soils have less than 51 inches of organic material. Unlike Wallkill soils, they do not have mineral overwash over the organic horizon.

Hm—Houghton muck. This soil is in depressions and areas where water ponds. The areas range from 2 to 80 acres but average 5 acres. Slopes are 0 to 2 percent.

This soil has water at or near the surface during most of the year. It generally is not farmed. It is difficult to drain adequately because it has no natural drainage outlets. Capability unit IIIw-8; woodland group 4w23.

Ho—Houghton muck, drained. This soil is in irregularly shaped areas on broad flats. The areas range from 2 to 1,700 acres but average 80 acres. Slopes are 0 to 2 percent.

Included in mapping are small areas of nearly level and depressional, very poorly drained Palms, Adrian, Edwards, and Wallkill soils.

This soil has a seasonal high water table within 1 foot of the surface. Wetness and soil blowing are the major concerns in management.

Most areas of this soil are used for special crops (fig. 9) and cash-grain farming. The soil is well suited

Figure 9.—Onions growing on Houghton muck, drained.

to cultivated crops if it is adequately drained. It has severe limitations for most nonfarm uses. Capability unit IIIw-8; woodland group 4w23.

Landes Series

The Landes series consists of deep, moderately well drained, nearly level soils on bottom land. These soils are mainly between outwash terraces and a stream or river. They formed in recent, medium-textured alluvium over stratified sand. The native vegetation was mainly mixed hardwoods.

In a representative profile, the surface layer is very dark grayish-brown and dark-brown loam about 12 inches thick. The underlying material is brown loam in the upper 11 inches; mottled, brown sandy loam in the next 10 inches; and light-gray sand in the lower 27 inches.

Landes soils have moderately rapid or rapid permeability and a moderate available water capacity. The organic-matter content is high in the surface layer. Runoff is slow.

Representative profile of Landes loam, in a cultivated field, 200 feet east and 500 feet south of the NW corner of NE¼ sec. 35, T. 38 N., R. 2 E.

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) loam; weak, fine and medium, granular structure; friable; neutral; abrupt, smooth boundary.
A12—8 to 12 inches, dark-brown (10YR 3/3) loam; weak, medium, subangular blocky structure; friable; neutral; abrupt, smooth boundary.
C1—12 to 23 inches, brown (10YR 4/3) loam; moderate, medium, subangular blocky structure; friable; mildly alkaline; gradual, wavy boundary.
C2—23 to 33 inches, brown (10YR 4/3) sandy loam; common, medium, distinct, light brownish-gray (10YR 6/2) mottles; moderate, medium, subangular blocky structure; friable; strongly effervescent; moderately alkaline; clear, wavy boundary.
C3—33 to 60 inches, light-gray (10YR 7/2) stratified medium and coarse sand; single grained; loose; strongly effervescent; moderately alkaline.

Depth to the C1 horizon ranges from 8 to 16 inches. The Ap horizon is very dark grayish-brown (10YR 3/2) or brown (10YR 5/3) and is slightly acid or neutral. The A12, C1, and C2 horizons are loam, sandy loam, or stratified loam and medium and coarse sand. The C1 horizon ranges from slightly acid to moderately alkaline.

Landes soils are associated on the landscape with the well-drained Tyner soils. They have mottles below a depth of 23 inches, but Tyner soils do not.

La—Landes loam. This soil is in elongated areas on bottom land along the St. Joseph River and on narrow stream bottoms. The areas range from 5 to 100 acres but average 10 acres. Slopes are 0 to 2 percent.

Included in mapping are areas, less than 2 acres in size, of well-drained Tyner soils.

Frequent flooding is the major concern in management.

Most areas of this soil are in woods and scrub brush. The soil is poorly suited to crops because it is in small areas dissected by streams. Because of flooding, it has severe limitations for most nonfarm uses. Capability unit IIs-7; woodland group 1o8.

Made Land

Ma—Made land consists of areas that are filled with cinders, slag, or a combination of these, smoothed over, and covered with soil material. These areas range from 5 to 100 acres but average 10 acres.

Depending on the material used as fill, some areas are suitable for pasture or wildlife habitat and others are suitable for recreation facilities or building sites. Not assigned to a capability unit or a woodland group.

Marsh

Mc—Marsh is in depressions where shallow water stands throughout the year. Beneath the shallow water are thick layers of organic material. Many areas of marsh dry up during years with less than normal rainfall. Marshes range from 2 to 20 acres but average 5 acres.

Cattails, rushes, sedges, willows, and other water-tolerant plants grow abundantly and provide habitat for wildlife. Muskrat and mink live in the large marshes. Because marshes do not have outlets for tile or ditches, it is generally not practical to drain them for crops. Not assigned to a capability unit or a woodland group.

Martinsville Series

The Martinsville series consists of deep, well-drained, nearly level and moderately sloping soils on outwash plains and terraces. These soils are mainly on broad flats and sloping areas between the glacial moraine and the outwash plains. They formed in stratified silt and sand. The native vegetation was mainly hardwoods.

In a representative profile, the surface layer is dark grayish-brown loam about 8 inches thick. The subsurface layer is dark-brown loam 3 inches thick. The subsoil is 26 inches thick. It is yellowish-brown, friable sandy clay loam in the upper 11 inches and yellowish-brown, friable loam in the lower 15 inches. The underlying material is yellowish-brown, stratified silt and sand that extends to a depth of 60 inches.

Martinsville soils have moderate permeability and a high available water capacity. The organic-matter content is moderate in the surface layer. Runoff is slow or medium.

Representative profile of Martinsville loam, 0 to 2 percent slopes, in a cultivated field, 1,000 feet east and 400 feet north of the SW corner of NE¼ sec. 21, T. 36 N., R. 2 E.

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) loam; weak, fine, granular structure; friable; slightly acid; abrupt, smooth boundary.
A2—8 to 11 inches, dark-brown (10YR 4/3) loam; weak, medium, subangular blocky structure; friable; slightly acid; clear, wavy boundary.
B21t—11 to 22 inches, yellowish-brown (10YR 5/4) sandy clay loam; moderate, medium, subangular blocky structure; friable; few, discontinuous, faint, thin, dark-brown (7.5YR 4/4) clay films on faces of peds; 2-inch band of sandy loam; slightly acid; clear, wavy boundary.
B22t—22 to 32 inches, yellowish-brown (10YR 5/4) loam; moderate, medium, prismatic structure; friable; thick pale-brown (10YR 6/3) silt coatings on vertical faces of peds; common, discontinuous, distinct, thin, dark-brown (7.5YR 4/4) clay films on horizontal faces of peds; medium acid; gradual, wavy boundary.

B3—32 to 37 inches, yellowish-brown (10YR 5/4) loam; weak, medium, subangular blocky structure; friable; medium acid; gradual, wavy boundary.
C—37 to 60 inches, yellowish-brown (10YR 5/4) stratified silt and sand; weak, coarse, subangular blocky structure; friable; neutral.

The solum is 36 to 50 inches thick. The Ap horizon is dark grayish brown (10YR 4/2), brown (10YR 5/3), or yellowish brown (10YR 5/4). It is slightly acid or neutral. The B horizon has a hue of 10YR, 7.5YR, and 5Y, value of 5, and chroma of 3 or 4. It is dominantly loam but ranges to sandy clay loam.

Martinsville soils are associated on the landscape with the well-drained Riddles soils, the somewhat poorly drained Whitaker soils, and the very poorly drained Rensselaer soils. Martinsville soils are browner than Whitaker and Rensselaer soils, and they are not mottled. They have coarser textured B and C horizons than Riddles soils.

MeA—Martinsville loam, 0 to 2 percent slopes. This soil is in irregularly shaped areas on broad flats. The areas range from 5 to 160 acres but average 60 acres. This soil has the profile described as representative of the series.

Included in mapping are areas, less than 2 acres in size, of nearly level, well-drained Riddles and Oshtemo soils.

This soil has few or no limitations for farming.

Most areas of this soil are used for cash-grain farming. The soil is well suited to all crops commonly grown in the county and has slight limitations for most nonfarm uses. Capability unit I-1; woodland group 1o1.

MeB2—Martinsville loam, 2 to 6 percent slopes, eroded. This soil is in elongated or irregularly shaped areas on knolls. The areas range from 2 to 160 acres but average 15 acres. The soil has a profile similar to the one described as representative of the series, but its surface layer is thinner, and in most places it is shallower to stratified sand and silt. Some yellowish-brown sandy clay loam from the subsoil is mixed with the surface layer.

Included in mapping are areas, less than 2 acres in size, of gently sloping, well-drained Riddles and Oshtemo soils.

Erosion is the major concern in management.

Most areas of this soil are used for cash-grain farming. The soil is well suited to all crops commonly grown in the county. Erosion control is needed. It has slight limitations for most nonfarm uses. Capability unit IIe–3; woodland group 1o1.

MeC2—Martinsville loam, 6 to 12 percent slopes, eroded. This soil is in irregularly shaped areas on narrow, elongated side slopes and knolls. The areas range from 2 to 20 acres but average 10 acres. The soil has a profile similar to the one described as representative of the series, but its surface layer is thinner, and it is shallower to stratified sand and silt. Some yellowish-brown sandy clay loam from the subsoil is mixed with the surface layer.

Included in mapping are areas, less than 2 acres in size, of moderately sloping, well-drained Oshtemo soils and gently sloping, well-drained Riddles soils.

Erosion is the major concern in management.

Most areas of this soil are used for cash-grain farming. The soil is suited to most crops commonly grown in the county. Erosion control is needed. It has moderate limitations for most nonfarm uses. Capability unit IIIe-1; woodland group 1o1.

Maumee Series

The Maumee series consists of deep, very poorly drained, nearly level and depressional soils on outwash plains. These soils are mainly on low depressional flats and along stream channels. They formed in sandy glacial outwash or stream alluvium. The native vegetation was mainly marsh grass and water-tolerant trees.

In a representative profile, the surface layer is loamy fine sand about 14 inches thick. It is very dark gray in the upper part and very dark grayish brown in the lower part. The underlying material is dark-gray, friable fine sand in the upper 14 inches; light brownish-gray, friable fine sand in the next 4 inches; dark grayish-brown, friable sand in the next 16 inches; and gray, loose sand to a depth of 65 inches.

Maumee soils have rapid permeability and a low available water capacity. The organic-matter content is high in the surface layer. Runoff is very slow or ponded.

Representative profile of Maumee loamy fine sand, in a cultivated field, 200 feet east and 550 feet north of the SW corner of sec. 32, T. 38 N., R. 4 E.

Ap—0 to 10 inches, very dark gray (10YR 3/1) loamy fine sand; weak, fine, granular structure; friable; neutral; clear, smooth boundary.
A12—10 to 14 inches, very dark grayish-brown (10YR 3/2) loamy fine sand; weak, fine, granular structure; friable; neutral; abrupt, smooth boundary.
C1g—14 to 28 inches, dark-gray (10YR 4/1) fine sand; weak, fine, subangular blocky structure; friable; slightly acid; gradual, wavy boundary.
C2g—28 to 32 inches, light brownish-gray (10YR 6/2) fine sand; weak, fine, subangular blocky structure, friable; slightly acid; gradual, wavy boundary.
A1bg—32 to 48 inches, dark grayish-brown (10YR 4/2) sand; weak, medium, subangular blocky structure; friable; neutral; gradual, wavy boundary.
C3—48 to 65 inches, gray (10YR 5/1) sand; single grained; loose; neutral.

The A horizon is 14 to 18 inches thick. It is black (N 2/1), very dark gray (10YR 3/1), or very dark grayish brown (10YR 3/2). The C horizon is slightly acid or neutral.

Maumee soils are associated on the landscape with the very poorly drained Gilford and Rensselaer soils. Maumee soils are coarser textured than those soils.

Mf—Maumee loamy fine sand. This soil is in irregularly shaped areas on broad depressional flats. The areas range from 2 to 100 acres but average 20 acres. Slopes are 0 to 2 percent.

Included in mapping are small areas of very poorly drained Gilford and Rensselaer soils and soils that are similar to this Maumee soil but have a surface layer less than 14 inches thick.

This soil has a seasonal high water table within 1 foot of the surface. Wetness is the major concern in management.

Most areas of this soil are used for cash-grain farming. Some areas are used for special crops. If it is adequately drained, the soil is well suited to most crops commonly grown in the county, but it has severe limitations for most nonfarm uses. Capability unit IIIw-1; woodland group 4w21.

Mg—Maumee mucky loamy fine sand. This soil is on

broad depressional flats adjacent to muck soils. It is on slightly higher areas surrounding Adrian soils. It has less than 16 inches of organic material over sand. The areas range from 2 to 200 acres, but average 15 acres. Slopes are 0 to 2 percent.

Included in mapping are areas, less than 2 acres in size, of very poorly drained Maumee loamy fine sand and Adrian muck. Also included are finer textured Gilford soils.

This soil has a seasonal high water table within 1 foot of the surface. Wetness is the major concern in management.

Most areas of this soil are used for cash-grain farming. Some are used for special crops. If it is adequately drained, the soil is well suited to most crops commonly grown in the county, but it has severe limitations for most nonfarm uses. Capability unit IIIw-1; woodland group 4w21.

Metea Series

The Metea series consists of deep, well-drained, gently sloping to moderately sloping soils on till plains. These soils are mainly on knolls and ridges. They formed in loamy fine sand, 20 to 40 inches thick, and the underlying loamy glacial till. The native vegetation was mainly mixed hardwoods.

In a representative profile, the surface layer is dark-brown loamy fine sand about 9 inches thick. The subsoil is 41 inches thick. It is yellowish-brown, very friable loamy fine sand in the upper 11 inches; light yellowish-brown, loose sand in the next 14 inches; strong-brown, friable sandy clay loam in the next 5 inches; and yellowish-brown, firm light clay loam in the lower 11 inches. The underlying material is brown loam that extends to a depth of 72 inches.

Metea soils have very rapid permeability in the upper part and moderate permeability in the lower part. They have a moderate available water capacity. The organic-matter content is moderate in the surface layer. Runoff is slow.

Representative profile of Metea loamy fine sand, 4 to 10 percent slopes, in a cultivated field, 320 feet south and 100 feet west of the NE corner of sec. 34, T. 36 N., R. 2 E.

Ap—0 to 9 inches, dark-brown (10YR 4/3) loamy fine sand; weak, fine, granular structure; very friable; mixed with yellowish-brown (10YR 5/4) subsoil material; neutral; abrupt, smooth boundary.

B21—9 to 20 inches, yellowish-brown (10YR 5/4) loamy fine sand; weak, fine, granular structure; very friable; neutral; clear, wavy boundary.

B22—20 to 29 inches, light yellowish-brown (10YR 6/4) sand; single grained; loose; 15 percent shale fragments 1 inch in diameter; neutral; clear, wavy boundary.

B23—29 to 34 inches, light yellowish-brown (10YR 6/4) sand; single grained; loose; two strong-brown (7.5YR 5/6) bands of sandy loam 1/2 inch thick; 10 percent pebbles 1/2 inch in diameter; neutral; clear, smooth boundary.

IIB24t—34 to 39 inches, strong-brown (7.5YR 5/6) sandy clay loam; moderate, medium, subangular blocky structure; friable; few, discontinuous, faint, thin, dark-brown (7.5YR 4/4) clay films on faces of peds; common, discontinuous, distinct, thin, pale-brown (10YR 6/3) silt coatings on faces of peds; 2 percent pebbles 1/2 inch in diameter; medium acid; clear, smooth boundary.

IIB25t—39 to 50 inches, yellowish-brown (10YR 5/4) light clay loam; moderate, medium, subangular blocky structure; firm; common, discontinuous, faint, thin, dark-brown (10YR 4/3) clay films on faces of peds; 5 percent pebbles, 1 inch in diameter; medium acid; gradual, wavy boundary.

IIC—50 to 72 inches, brown (10YR 5/3) loam; massive; friable; 5 percent pebbles 1/2 inch in diameter; strongly effervescent; moderately alkaline.

The solum is 30 to 60 inches thick. The sandy material overlying the IIB21t horizon is 20 to 40 inches thick. The Ap horizon is dark brown (10YR 4/3), dark grayish brown (10YR 4/2), or brown (10YR 5/3). The B21 and B22 horizons are yellowish-brown (10YR 5/6 or 10YR 5/4) or light yellowish-brown (10YR 6/4) loamy fine sand and sand. Some profiles do not have a B23 horizon. The IIBt horizon is sandy clay loam or clay loam.

Metea soils are associated on the landscape with the well-drained Riddles and Miami soils and the somewhat poorly drained Aubbeenaubbee soils. Unlike Riddles and Miami soils, Metea soils have an A horizon of loamy fine sand and an upper B horizon of sand. They do not have mottles in the solum as do Aubbeenaubbee soils.

MkB—Metea loamy fine sand, 4 to 10 percent slopes. This soil is in irregularly shaped areas on broad till plains. The areas range from 2 to 40 acres but average 5 acres.

Included in mapping are small areas of gently sloping Riddles loam and Miami loam. Also included are areas where slopes are less than 4 percent or more than 10 percent.

Erosion is the major concern in management.

Most areas of this soil are used for cash-grain farming. The soil is suited to most crops commonly grown in the county and has slight limitations for most nonfarm uses. Capability unit IIIe-13; woodland group 2s15.

Miami Series

The Miami series consists of deep, well-drained, gently sloping to strongly sloping soils on till plains. These soils formed in loamy glacial till. The native vegetation was mixed hardwoods.

In a representative profile, the surface layer is dark-brown loam about 8 inches thick. The subsurface layer is brown loam 6 inches thick. The subsoil is 24 inches thick. It is dark yellowish-brown, firm clay loam in the upper 6 inches and yellowish-brown, firm clay loam in the lower 18 inches. The underlying material is brown heavy loam that extends to a depth of 60 inches.

Miami soils have moderate and moderately slow permeability and a high available water capacity. The organic-matter content is generally moderate in the surface layer, but it is low where the soils are severely eroded. Runoff is medium to rapid.

Representative profile of Miami loam, 2 to 6 percent slopes, in a pasture, 175 feet west and 1,720 feet south of the NE corner of sec. 31, T. 37 N., R. 4 E.

Ap—0 to 8 inches, dark-brown (10YR 3/3) loam, light brownish gray (10YR 6/2) when dry; weak, medium, granular structure; friable; slightly acid; abrupt, smooth boundary.

A2—8 to 14 inches, brown (10YR 5/3) loam; weak, medium, subangular blocky structure; friable; neutral; clear, smooth boundary.

B21t—14 to 20 inches, dark yellowish-brown (10YR 4/4) clay loam; moderate, medium, subangular blocky structure; firm; few, faint, discontinuous, thin,

dark-brown (7.5YR 4/4) clay films on faces of peds; medium acid; gradual, wavy boundary.

B22t—20 to 38 inches, yellowish-brown (10YR 5/4) clay loam; moderate, medium, subangular blocky structure; firm; common, distinct, discontinuous, thin, dark-brown (7.5YR 4/4) clay films on faces of peds; few till pebbles; mildly alkaline; gradual, wavy boundary.

C—38 to 60 inches, brown (10YR 5/3) heavy loam; massive; friable; strongly effervescent; moderately alkaline.

The solum is 24 to 40 inches thick. The A1 or Ap horizon is dark-brown (10YR 3/3), dark grayish-brown (10YR 4/2), or brown (10YR 5/3) loam or clay loam. The Bt horizon is dominantly clay loam, but in some places it is silty clay loam. The B22t horizon ranges from slightly acid to mildly alkaline.

Miami soils are associated on the landscape with the well-drained Riddles soils and the somewhat poorly drained Crosier soils. Miami soils have a thinner solum than Riddles soils. Unlike Crosier soils, they do not have mottles in the B horizon.

MmB—Miami loam, 2 to 6 percent slopes. This soil is in elongated areas on knolls. The areas range from 2 to 40 acres but average 10 acres. This soil has the profile described as representative of the series.

Included in mapping are small areas of gently sloping, well-drained Riddles soils and nearly level and gently sloping, somewhat poorly drained Crosier soils. Also included are some areas of eroded soils. In these soils clay loam material from the subsoil is mixed into the surface layer.

Erosion is the major concern in management.

Most areas of this soil are used for cash-grain farming. The soil is well suited to most crops commonly grown in the county. Erosion control is needed. It has slight or moderate limitations for most nonfarm uses. Capability unit IIe-1; woodland group 1o1.

MmC2—Miami loam, 6 to 12 percent slopes, eroded. This soil is in irregularly shaped areas on narrow, elongated side slopes and knolls. The areas range from 2 to 20 acres but average 10 acres. This soil has a profile similar to the one described as representative of the series, but its surface layer is thinner, and some subsoil material is mixed into the surface layer.

Included in mapping are small areas of moderately sloping, well-drained Riddles soils. Also included are areas of severely eroded soils where the subsoil of dark yellowish-brown clay loam is exposed. Some severely eroded areas are shown on the detailed soil map by a special symbol.

Erosion is the major concern in management.

Most areas of this soil are used for cash-grain farming. The soil is suited to most crops commonly grown in the county. Erosion control is needed. It has moderate limitations for most nonfarm uses. Capability unit IIIe-1; woodland group 1o1.

MoC3—Miami clay loam, 6 to 12 percent slopes, severely eroded. This soil is in irregularly shaped areas on narrow, elongated side slopes and knolls. The areas range from 2 to 50 acres but average 5 acres. This soil has a profile similar to the one described as representative of the series, but almost all of the original surface layer has been removed by erosion and the clay loam subsoil is exposed. There are a few shallow gullies.

Included in mapping are small areas of moderately eroded Miami soils.

Erosion is the major concern in management.

Most areas of this soil are now in permanent pasture. The soil is not well suited to farming, and it has moderate limitations for most nonfarm uses. Capability unit IVe-1; woodland group 1o1.

MoD3—Miami clay loam, 12 to 18 percent slopes, severely eroded. This soil is on narrow, elongated ridgetops and knolls along small streams and drainageways. The areas range from 2 to 10 acres but average 5 acres. This soil has a profile similar to the one described as representative of the series, but almost all of the original surface layer has been removed by erosion and the clay loam subsoil is exposed. There are a few shallow gullies.

Included in mapping are small areas of soils that are not so severely eroded.

Erosion is the major concern in management.

Most areas of this soil are in permanent pasture. This soil is poorly suited to cultivated crops and has severe limitations for most nonfarm uses. Capability unit VIe-1; woodland group 1o1.

Milford Series

The Milford series consists of deep, poorly drained, depressional soils on lake plains. These soils are mainly in depressions on broad flats, in shallow basins, and slack water areas. They formed in stratified lacustrine deposits. The native vegetation was mixed hardwoods.

In a representative profile, the surface layer is very dark gray silty clay loam about 15 inches thick. The subsoil is 31 inches thick. It is mottled, gray, firm heavy silty clay loam in the upper 17 inches and mottled, gray, firm silty clay loam in the lower 14 inches. The underlying material is mottled, grayish-brown and yellowish-brown, stratified loam, clay loam, and sandy loam that extends to a depth of 72 inches.

Milford soils have moderately slow permeability and a high available water capacity. The organic-matter content is high in the surface layer. Runoff is very slow or ponded.

Representative profile of Milford silty clay loam, in a pasture, 200 feet east and 100 feet north of the SW corner of SE¼ sec. 5, T. 36 N., R. 4 E.

Ap—0 to 11 inches, very dark gray (10YR 3/1) silty clay loam; weak, medium, subangular blocky structure; firm; common fine roots; slightly acid; clear, smooth boundary.

A12—11 to 15 inches, very dark gray (10YR 3/1) silty clay loam; weak, medium, subangular blocky structure; firm; common fine roots; few streaks of grayish brown (2.5Y 5/2); slightly acid; clear, smooth boundary.

B21g—15 to 32 inches, gray (5Y 6/1) heavy silty clay loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; moderate, coarse, subangular blocky structure; firm; few fine roots; common, continuous, distinct, medium, dark-gray (10YR 4/1) organic coatings; neutral; clear, wavy boundary.

B22g—32 to 46 inches, gray (5Y 6/1) silty clay loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles and few, fine, faint, grayish-brown (2.5Y 5/2) mottles; weak, coarse, subangular blocky structure; firm; few fine roots; sandy loam layer between depths of 37 and 39 inches; mildly alkaline; clear, wavy boundary.

C1—46 to 59 inches, grayish-brown (2.5Y 5/2) loam; common, medium, faint, gray (5Y 6/1) and yellowish-brown (10YR 5/4) mottles; massive;

friable; sandy loam lenses between depths of 50 and 52 inches; strongly effervescent; moderately alkaline; gradual, wavy boundary.

C2—59 to 72 inches, yellowish-brown (10YR 5/4) stratified clay loam, loam, and sandy loam; common, medium, distinct, gray (5Y 6/1) mottles; massive; friable; strongly effervescent; moderately alkaline.

The solum is 36 to 60 inches thick. The Ap and A12 horizons are black (10YR 2/1) or very dark gray (10YR 3/1) and are 12 to 18 inches thick. The B2 horizon is silty clay or silty clay loam. It is neutral or mildly alkaline.

Milford soils are associated on the landscape with the very poorly drained Brookston and Rensselaer soils and the somewhat poorly drained Del Rey soils. Milford soils have a finer textured B horizon than Brookston and Rensselaer soils. They have a thicker, darker A horizon than Del Rey soils.

Mp—Milford silty clay loam. This soil is in irregularly shaped areas on broad depressional flats. The areas range from 2 to 400 acres but average 40 acres. Slopes are 0 to 2 percent.

Included in mapping are a few small areas of depressional, very poorly drained Brookston and Rensselaer soils.

The soil has a seasonal high water table within 1 foot of the surface. Wetness is the major concern in management.

Most areas of this soil are used for cash-grain farming. If it is adequately drained, the soil is suited to most crops commonly grown in the county. It has severe limitations for most nonfarm uses. Capability unit IIw-1; woodland group 2w11.

Morley Series

The Morley series consists of deep, well drained and moderately well drained, gently sloping to strongly sloping soils on dissected till plains and moraines. These soils are mainly on broad undulating areas and long ridges on glacial moraines. They formed in clay loam and silty clay loam glacial till. The native vegetation was mixed hardwoods.

In a representative profile, the surface layer is dark-brown silt loam about 5 inches thick. The subsurface layer is brown light silty clay loam 5 inches thick. The subsoil is 28 inches thick. It is yellowish-brown, firm silty clay loam in the upper 7 inches; yellowish-brown, very firm silty clay in the next 15 inches; and brown, firm silty clay loam in the lower 6 inches. The underlying material is brown clay loam that extends to a depth of 60 inches.

Morley soils have slow permeability and a high available water capacity. The organic-matter content is moderate in the surface layer. Runoff is medium and rapid.

Representative profile of Morley silt loam, 2 to 6 percent slopes, eroded, in a pasture, 450 feet east and 375 feet south of the center of SE¼ sec. 11, T. 38 N., R. 1 W.

Ap—0 to 5 inches, dark-brown (10YR 4/3) silt loam; weak, fine, subangular blocky structure; friable; mixed with some material from the A2 horizon; many fine roots; medium acid; abrupt, smooth boundary.

A2—5 to 10 inches, brown (10YR 5/3) light silty clay loam; moderate, fine, subangular blocky structure; friable; mixed with some dark-brown (10YR 4/3) material; few fine roots; medium acid; clear, smooth boundary.

B21t—10 to 17 inches, yellowish-brown (10YR 5/4) silty clay loam; moderate, medium, subangular blocky structure; firm; common, discontinuous, distinct, medium, dark-brown (10YR 4/3) clay films on faces of peds; few, patchy, distinct, thin, light brownish-gray (10YR 6/2) silt coatings on vertical faces of peds and in pockets; few fine roots; strongly acid; clear, wavy boundary.

B22t—17 to 32 inches, yellowish-brown (10YR 5/4) silty clay; moderate, coarse, subangular blocky structure; very firm; common, continuous, prominent, thick, dark-brown (10YR 3/3) clay films on faces of peds; few distinct iron and manganese concretions; few fine roots; slightly acid; clear, wavy boundary.

B23t—32 to 38 inches, brown (10YR 5/3) silty clay loam; moderate, medium, subangular blocky structure; firm; common, discontinuous, distinct, medium, dark-brown (10YR 4/3) clay films on faces of peds; few fine pebbles; neutral; clear, smooth boundary.

C—38 to 60 inches, brown (10YR 5/3) clay loam, massive; firm; 15 percent gravel; strongly effervescent; moderately alkaline.

The solum is 28 to 44 inches thick. The Ap horizon is dark grayish brown (10YR 4/2), brown (10YR 5/3), or dark brown (10YR 4/3). The B horizon is medium acid or strongly acid in the upper part and slightly acid to moderately alkaline in the lower part. The C horizon is clay loam or silty clay loam.

Morley soils are associated on the landscape with the somewhat poorly drained Blount soils and the poorly drained Milford soils. Morley soils are not so gray as Blount and Milford soils, and they are not mottled.

MrB2—Morley silt loam, 2 to 6 percent slopes, eroded. This soil is in elongated areas that range from 2 to 140 acres but average 40 acres. It has the profile described as representative of the series. Slopes are convex.

Included in mapping are small areas of nearly level, somewhat poorly drained Blount soils and areas of more sloping soils.

Erosion is the major concern in management.

Most areas of this soil are used for cash-grain farming. The soil is suited to most crops commonly grown in the county if erosion is controlled, but it has moderate or severe limitations for most nonfarm uses. Capability unit IIe-6; woodland group 1o1.

MrC2—Morley silt loam, 6 to 12 percent slopes, eroded. This soil is in irregularly shaped areas on elongated side slopes and knolls. The areas range from 2 to 20 acres but average 5 acres. This soil has a profile similar to the one described as representative of the series, but its surface layer is thinner.

Included in mapping are small areas of nearly level, somewhat poorly drained Blount soils. Also included are small areas of severely eroded soils where the subsoil of yellowish-brown silty clay loam is exposed.

Erosion is the major concern in management.

Most areas of this soil are used for cash-grain farming or permanent pasture. The soil is suited to most crops commonly grown in the county if erosion is controlled, but it has severe limitations for most nonfarm uses. Capability unit IIIe-6; woodland group 1o1.

MsD3—Morley silty clay loam, 12 to 18 percent slopes, severely eroded. This soil is in irregularly shaped areas on ridges and knolls. The areas range from 2 to 60 acres but average 5 acres. This soil has a profile similar to the one described as representative

of the series, but the original surface layer has been removed by erosion. There are a few gullies throughout the area.

Included in mapping are a few small areas of moderately sloping soils.

Erosion is the major concern in management.

Most areas of this soil are in permanent pasture. The soil is not suited to row crops, and it has severe limitations for most nonfarm uses. Capability unit VIe-6; woodland group 1o1.

Oshtemo Series

The Oshtemo series consists of deep, well-drained, nearly level to strongly sloping soils on outwash plains and terraces. The native vegetation was mainly mixed hardwoods.

In a representative profile, the surface layer is very dark grayish-brown sandy loam about 6 inches thick. The subsurface layer is dark-brown sandy loam 10 inches thick. The subsoil is 38 inches thick. It is dark-brown, firm gravelly sandy clay loam in the upper 12 inches and strong-brown, friable loamy sand in the lower 26 inches. The underlying material is light yellowish-brown, stratified sand and gravelly sand that extends to a depth of 60 inches.

Oshtemo soils have moderately rapid permeability and a low available water capacity. The organic-matter content is high in the surface layer. Runoff is slow and medium.

Representative profile of Oshtemo sandy loam, 2 to 6 percent slopes, in a gravel pit, 1,600 feet east and 400 feet north of the SW corner of sec. 10, T. 38 N., R. 2 E.

Ap—0 to 6 inches, very dark grayish-brown (10YR 3/2) sandy loam, light brownish gray (10YR 6/2) when dry; moderate, medium, granular structure; very friable; slightly acid; abrupt, smooth boundary.

A21—6 to 10 inches, dark-brown (10YR 4/3) sandy loam; weak, medium, platy structure parting to weak, fine, granular; very friable; dark grayish-brown (10YR 4/2) root channel fillings and worm casts; slightly acid; clear, wavy boundary.

A22—10 to 16 inches, dark-brown (7.5YR 4/4) sandy loam; weak, medium, subangular blocky structure; friable; medium acid; clear, wavy boundary.

B2t—16 to 28 inches, dark-brown (7.5YR 4/4) gravelly sandy clay loam; moderate, medium, subangular blocky structure; firm; common, discontinuous, distinct, thin, very dark grayish-brown (10YR 3/2) clay films on horizontal and vertical faces of peds; 20 percent gravel and shale; clay bridgings on sand grains; strongly acid; clear, wavy boundary.

B3—28 to 54 inches, strong-brown (7.5YR 5/6) loamy sand; weak, medium, subangular blocky structure; friable; 10 percent gravel and shale; medium acid; clear, wavy boundary.

C—54 to 60 inches, light yellowish-brown (10YR 6/4) stratified sand and gravelly sand; single grained; loose; strongly effervescent; moderately alkaline.

The solum is 40 to 60 inches thick. The Ap and A2 horizons are very dark grayish brown (10YR 3/2), dark grayish brown (10YR 4/2), or brown (10YR 5/3). They are slightly acid or medium acid. The Bt horizon is light loam, sandy loam, sandy clay loam, or gravelly sandy clay loam. The C horizon is slightly acid to moderately alkaline.

Oshtemo soils are associated on the landscape with the well-drained Tyner, Elston, and Fox soils and the somewhat poorly drained Brady soils. Oshtemo soils have a finer textured solum than Tyner soils, and they have a thinner, lighter colored A horizon than Elston soils. Oshtemo soils have a thicker solum than Fox soils. Unlike Brady soils, they are not mottled.

OsA—Oshtemo sandy loam, 0 to 2 percent slopes. This soil is in irregularly shaped areas on broad flats. The areas range from 2 to 1,000 acres but average 60 acres. The soil has a profile similar to the one described as representative of the series, but its surface layer is thicker.

Included in mapping are soils that have a surface layer of loamy sand. Also included are small areas of nearly level, well-drained Tyner soils and nearly level, somewhat poorly drained Brady soils.

Droughtiness is the major concern in management. Soil blowing is a hazard when the soil is dry if it has no protective cover.

This soil is used mostly for cash-grain farming (fig. 10). It is suited to most crops commonly grown in the county and has slight limitations for most nonfarm uses. Capability unit IIIs-2; woodland group 3s17.

OsB—Oshtemo sandy loam, 2 to 6 percent slopes. This soil is in irregularly shaped areas on broad flats at a slightly higher elevation than the surrounding soils. The areas range from 2 to 240 acres but average 10 acres. This soil has the profile described as representative of the series.

Included in mapping are soils that have a surface layer of loamy sand. Also included are small areas of nearly level and gently sloping, well-drained Tyner loamy sand and a few areas where slopes are less than 2 percent.

Droughtiness is the major concern in management, and soil blowing is a hazard when the soil is dry if it has no protective cover.

Most areas of this soil are cultivated. The soil is suited to most crops commonly grown in the county. It is also used for urban development, and has slight limitations for most nonfarm uses. Capability unit IIIe–13; woodland group 3s17.

OsC2—Oshtemo sandy loam, 6 to 12 percent slopes, eroded. This soil is in elongated areas on short side slopes. The areas range from 2 to 80 acres but average 10 acres. This soil has a profile similar to the one described as representative of the series, but because of erosion, its surface layer is thinner and is mixed with some dark-brown material from the subsoil.

Included in mapping are small areas of moderately sloping, well-drained, Tyner loamy sand and some areas where slopes are less than 6 percent. Also included are small areas of Fox soils.

Droughtiness and erosion are the major concerns in management. Soil blowing is a hazard when the soil is dry if it has no protective cover.

This soil is suited to small grain and to grass and legumes for forage. Most areas are idle or are used for urban development. The soil has moderate limitations for most nonfarm uses. Capability unit IIIe-13; woodland group 3s17.

OsD—Oshtemo sandy loam, 12 to 18 percent slopes. This soil is in elongated areas above broad outwash flats. The areas range from 2 to 60 acres but average 5 acres. Slopes are short. This soil has a profile similar to the one described as representative of the series,

Figure 10.—Alfalfa growing on Oshtemo sandy loam, 0 to 2 percent slopes. The corn in the background is on a poorly drained soil.

but its surface layer is thinner and is mixed with some material from the subsoil. It is shallower to the underlying material.

Included in mapping are areas of strongly sloping, well-drained Tyner loamy sand and areas where slopes are more than 18 percent. Also included are small areas of Fox soils.

Droughtiness and slope are the major concerns in management.

Most areas of this soil are in woodland. Because of slope, the soil is poorly suited to crops. It has severe limitations for most nonfarm uses. Capability unit IVe–13; woodland group 3s17.

Palms Series

The Palms series consists of very poorly drained, nearly level and depressional, organic soils that are moderately deep over loamy mineral material. These soils are mainly on the broad Kankakee muck flats and in depressions on till plains. The native vegetation was mainly reeds and sedges and some water-tolerant hardwoods.

In a representative profile, the surface layer is black muck about 12 inches thick. The layer below that is dark reddish-brown, friable muck 9 inches thick. The underlying material is mottled, very dark gray loam in the upper 5 inches; mottled, gray clay loam in the next 14 inches; and grayish-brown heavy sandy loam to a depth of 60 inches.

Palms soils have rapid permeability in the organic layer and moderate permeability in the mineral layer. They have a high available water capacity. The

organic-matter content is very high in the upper 21 inches. Runoff is very slow or ponded.

Representative profile of Palms muck, drained, in a cultivated field, 1,020 feet south and 150 feet west of the NE corner of NW¼ sec. 19, T. 37 N., R. 1 E.

Oap—0 to 12 inches, black (N 2/0) sapric material, dark reddish brown (5YR 2/2) rubbed and pressed; 10 percent fiber before and after rubbing; weak, fine, granular structure; friable; herbaceous; slightly acid; abrupt, smooth boundary.

Oa2—12 to 21 inches, dark reddish brown (5YR 3/2 and 5YR 2/2) sapric material, broken face and pressed; 20 percent fiber, less than 10 percent rubbed; weak, medium, platy structure; friable; mineral content 5 percent; herbaceous; medium acid; gradual, wavy boundary.

IIC1—21 to 26 inches, very dark gray (10YR 3/1) loam; few, fine, distinct, yellowish-brown (10YR 5/4) mottles; weak, medium, subangular blocky structure; friable; few, fine, black (5YR 2/1) organic coatings on vertical faces of peds; medium acid; clear, wavy boundary.

IIC2—26 to 40 inches, gray (10YR 5/1) clay loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, fine, subangular blocky structure; firm; common, fine, very dark gray (10YR 3/1) organic coatings on vertical faces of peds; medium acid; clear, wavy boundary.

IIC3—40 to 60 inches, grayish-brown (10YR 5/2) heavy sandy loam; massive; friable; neutral.

Depth to the underlying mineral horizon ranges from 16 to 50 inches. The surface layer is black (10YR 2/1 or 7.5YR 2/1) or very dark brown (10YR 2/2) sapric or hemic material. The IIC horizon ranges from heavy sandy loam to clay loam.

Palms soils are associated on the landscape with the very poorly drained Houghton, Adrian, and Edwards mucks. Palms soils have a thinner layer of organic material than Houghton soils. Palms soils are underlain by loamy material, but Adrian soils are underlain by sand and Edwards soils by marl.

Pa—Palms muck, drained. This soil is in irregularly shaped areas on broad flats and in depressions. The areas range from 2 to 230 acres but average 40 acres. Slopes are 0 to 2 percent.

Included in mapping are small areas of very poorly drained Houghton, Edwards, and Adrian soils. Also included are small areas of soils that have an organic layer less than 16 inches thick. Areas of Palms muck that are not drained are shown on the detailed soil map by a special symbol.

This soil has a seasonal high water table within 1 foot of the surface. Wetness is the major concern in management. Soil blowing is a hazard.

Most areas of this soil are used for special crops and cash-grain farming. If it is adequately drained, the soil is well suited to all crops commonly grown in the county. It has severe limitations for all nonfarm uses. Capability unit IIw-10; woodland group 4w23.

Quinn Series

The Quinn series consists of deep, poorly drained, nearly level soils on outwash terraces. These soils are mainly on broad flats between somewhat poorly drained soils and very poorly drained outwash soils in depressions. They formed in loamy outwash. The native vegetation was mainly mixed hardwoods.

In a representative profile, the surface layer is very dark gray loam about 4 inches thick. The subsurface layer is gray loam 3 inches thick. The subsoil is 40 inches thick. It is mottled gray and dark-brown, friable loam in the upper 5 inches; mottled, gray, friable sandy loam in the next 7 inches; mottled gray and strong-brown, firm sandy loam in the next 8 inches; mottled gray, yellowish-brown, and strong-brown, friable light sandy loam in the next 15 inches; and mottled gray and yellowish-brown, friable loam in the lower 5 inches. The underlying material is mottled grayish-brown and yellowish-brown loamy medium sand and sand that extends to a depth of 72 inches.

Quinn soils have moderate permeability and a moderate available water capacity. The organic-matter content is high in the surface layer. Runoff is slow.

Representative profile of Quinn loam, in a wooded area, 300 feet west and 240 feet south of the NE corner of sec. 5, T. 37 N., R. 1 E.

A1—0 to 4 inches, very dark gray (10YR 3/1) loam; weak, fine, granular structure; friable; very strongly acid; abrupt, smooth boundary.

A2—4 to 7 inches, gray (10YR 6/1) loam; weak, thick, platy structure; friable; very dark gray (10YR 3/1) worm casts and fillings in old root channels; common dark concretions (iron and manganese oxides); very strongly acid; abrupt, smooth boundary.

B1g—7 to 12 inches, mottled gray (10YR 5/1) and dark-brown (7.5YR 4/4) loam; weak, medium, subangular blocky structure; friable; common, discontinuous, faint, thin, dark-gray (10YR 4/1) clay films on faces of peds and as linings in some pores; common dark concretions (iron and manganese oxides); very strongly acid; clear, wavy boundary.

B21tg—12 to 19 inches, gray (10YR 6/1) sandy loam; common, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; weak, medium, subangular blocky structure; friable; thin, discontinuous, grayish-brown (10YR 5/2) clay films in old root channels, as linings in pores, and on some faces of peds; many dark concretions (iron and manganese oxides); very strongly acid; clear, wavy boundary.

B22t—19 to 27 inches, mottled gray (10YR 5/1) and strong-brown (7.5YR 5/6) sandy loam; weak, coarse, prismatic structure parting to moderate, coarse, subangular blocky; firm; common, discontinuous, distinct, thin silt coatings on faces of prisms; common, discontinuous, distinct, thin clay films on faces of peds and as linings in pores; dark concretions (iron and manganese oxides); few pebbles and shale fragments; very strongly acid; clear, irregular boundary.

B31g—27 to 42 inches, mottled gray (10YR 5/1), yellowish-brown (10YR 5/4), and strong-brown (7.5YR 5/6) light sandy loam; pockets of loamy sand; weak, coarse, prismatic structure; friable; thin, discontinuous, gray (10YR 5/1) clay films as linings in common pores; many dark concretions (iron and manganese oxides); few pebbles and very fine shale fragments; very strongly acid; clear, wavy boundary.

B32g—42 to 47 inches, mottled gray (10YR 5/1) and yellowish-brown (10YR 5/6) loam; weak, coarse, subangular blocky structure; friable; thin discontinuous, gray (10YR 5/1) clay films as linings in some pores and on faces of some peds; many dark concretions (iron and manganese oxides); few pebbles and fine shale fragments; strongly acid; clear, broken boundary.

C—47 to 72 inches, mottled grayish-brown (10YR 5/2) and yellowish-brown (10YR 5/4) loamy medium sand and sand; 5 to 20 percent gravel and shale fragments; single grained; loose; slightly acid to neutral.

The solum is 40 to 60 inches thick. Some profiles have an Ap horizon that is very dark gray (10YR 3/1), dark gray

(10YR 4/1), or grayish brown (10YR 5/2). The A1 and A2 horizons are strongly acid or very strongly acid. The B horizon is very strongly acid or strongly acid. The B21tg and B22tg horizons are sandy loam or sandy clay loam. The B31g and B32g are light sandy loam, loam, or shaly sandy loam. The C horizon is sand or gravelly sand that contains shale fragments.

Quinn soils are associated on the landscape with the somewhat poorly drained Alida and Brady soils and the very poorly drained Rensselaer soils. Quinn soils have a grayer B2 horizon than Alida and Brady soils. They do not have so thick and so black an A horizon as Rensselaer soils.

Qu—Quinn loam. This soil is in irregularly shaped areas on broad flats. The areas range from 2 to 800 acres but average 60 acres. Slopes are 0 to 2 percent.

Included in mapping are areas, less than 2 acres in size, of nearly level, somewhat poorly drained Alida soils and depressional, very poorly drained Rensselaer soils.

This soil has a seasonal high water table within 1 foot of the surface. Wetness is the major concern in management.

Most areas of this soil are used for cash-grain farming. If it is adequately drained, the soil is well suited to most crops commonly grown in the county (fig. 11), but it has severe limitations for most nonfarm uses.

Figure 11.—Corn on Quinn loam. The trees in the background are on Hillsdale complex, 12 to 18 percent slopes.

Capability unit IIIw-12; woodland group 2w11.

Rensselaer Series

The Rensselaer series consists of deep, very poorly drained soils on flats. These soils are mainly in depressions parallel to the major streams on outwash plains. They formed in loamy and sandy, stratified lake sediment underlain by sandy outwash. The native vegetation was mainly water-tolerant hardwoods and grass.

In a representative profile, the surface layer is black loam about 11 inches thick. The subsoil is 30 inches thick. It is mottled, grayish-brown, firm loam in the upper 6 inches; gray, firm clay loam in the next 9 inches; light brownish-gray, friable, stratified sandy loam and loamy sand in the next 12 inches; and grayish-brown, friable sandy clay loam in the lower 3 inches. The underlying material is light brownish-gray loamy sand that extends to a depth of 60 inches.

Rensselaer soils have slow permeability and a high available water capacity. The organic-matter content is high in the surface layer. Runoff is very slow or ponded.

Representative profile of Rensselaer loam, in a cultivated field, 200 feet west and 180 feet north of the center of SW¼ sec. 19, T. 37 N., R. 2 E.

Ap—0 to 8 inches, black (10YR 2/1) loam; moderate, medium, subangular blocky structure parting to weak, medium, granular; friable; medium acid; abrupt, smooth boundary.

A12—8 to 11 inches, black (10YR 2/1) loam; many, medium, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium, subangular blocky structure; friable; slightly acid; clear, wavy boundary.

B1—11 to 17 inches, grayish-brown (2.5Y 5/2) loam; few, fine, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium, subangular blocky structure; firm; fillings of black (10YR 2/1) material in old root channels; neutral; clear, wavy boundary.

B2tg—17 to 26 inches, gray (5Y 5/1) clay loam; moderate, medium, prismatic structure; firm; distinct, thin, discontinuous, black (10YR 2/1) clay films on faces of peds and in pores; neutral; clear, wavy boundary.

B31g—26 to 38 inches, light brownish-gray (2.5Y 6/2) stratified sandy loam and loamy sand; weak, medium, subangular blocky structure; friable; 15 percent gravel; neutral; clear, wavy boundary.

B32g—38 to 41 inches, grayish-brown (2.5Y 5/2) sandy clay loam; weak, medium, subangular blocky structure; friable; mildly alkaline; clear, wavy boundary.

C—41 to 60 inches, light brownish-gray (2.5Y 6/2) gravelly loamy sand; single grained; loose; strongly effervescent; moderately alkaline.

The solum is 28 to 48 inches thick. The Ap or A1 horizon ranges from black (N 2/0 or 10YR 2/1) to very dark grayish brown (10YR 3/2). The B2 horizon is silty clay loam, clay loam, or loam and is neutral or mildly alkaline. The C horizon is neutral or moderately alkaline.

Rensselaer soils are associated on the landscape with the very poorly drained Gilford and Maumee soils and the poorly drained Quinn soils. Rensselaer soils have a finer textured B horizon than Gilford and Maumee soils. They have a thicker and blacker A horizon and are less acid than Quinn soils.

Re—Rensselaer loam. This soil is in irregularly shaped areas on broad, depressional flats. The areas range from 2 to 1,000 acres but average 100 acres. Slopes are 0 to 2 percent. This soil has the profile described as representative of the series.

Included in mapping are small areas of depressional, very poorly drained Gilford and Maumee soils and nearly level, poorly drained Quinn soils.

The soil has a seasonal high water table within 1 foot of the surface. Wetness is the major concern in management.

Most areas of this soil are used for cash-grain farming. Special crops are also grown. If it is adequately drained, the soil is well suited to most crops commonly grown in the county, but it has severe limitations for most nonfarm uses. Capability unit IIw-1; woodland group 2w11.

Rm—Rensselaer mucky loam. This soil is on broad, depressional flats adjacent to muck soils. It is in slightly higher areas surrounding Palms soils. The areas range from 2 to 280 acres but average 20 acres. This soil has a profile similar to the one described as representative of the series, but it has as much as 16 inches of organic material over the loamy material. It remains wet for longer periods after heavy rains than Rensselaer loam.

Included in mapping are small areas of very poorly drained loam and areas of Palms muck.

This soil has a seasonal high water table within 1 foot of the surface. Wetness is the major concern in management.

Most areas of this soil are used for cash-grain farming. If it is adequately drained, the soil is well suited to most crops commonly grown in the county and to special crops. It has severe limitations for most nonfarm uses. Capability unit IIw-1; woodland group 2w11.

Riddles Series

The Riddles series consists of deep, well-drained, nearly level to strongly sloping soils on till plains. These soils formed in loamy glacial till. The native vegetation was mixed hardwoods.

In a representative profile, the surface layer is dark grayish-brown loam about 9 inches thick. The subsoil is 53 inches thick. It is dark yellowish-brown, firm loam in the upper 3 inches; dark yellowish-brown, firm clay loam in the next 18 inches; yellowish-brown, firm light clay loam in the next 16 inches; and brown, firm loam in the lower 16 inches. The underlying material is brown loam that extends to a depth of 72 inches.

Riddles soils have moderate permeability and a high available water capacity. The organic-matter content is moderate in the surface layer. Runoff is slow to rapid.

Representative profile of Riddles loam, 2 to 6 percent slopes, in a cultivated field, 300 feet north and 200 feet east of the SW corner of sec. 1, T. 36 N., R. 2 E.

Ap—0 to 9 inches, dark grayish-brown (10YR 4/2) loam; weak, fine, granular structure; friable; slightly acid; abrupt, wavy boundary.

B1—9 to 12 inches, dark yellowish-brown (10YR 4/4) loam; weak, medium, subangular blocky structure; firm; dark grayish-brown (10YR 4/2) channel fillings; slightly acid; clear, wavy boundary.

B21t—12 to 21 inches, dark yellowish-brown (10YR 4/4) clay loam; moderate, medium, subangular blocky structure; firm; common, discontinuous, distinct, medium clay films on some faces of peds; few, fine, light brownish-gray (10YR 6/2) silt coatings on some faces of peds; medium acid; gradual, wavy boundary.

B22t—21 to 30 inches, dark yellowish-brown (10YR 4/4) clay loam; moderate, medium, subangular blocky structure; firm; common, discontinuous, distinct, medium clay films on all faces of peds; medium acid; gradual, wavy boundary.

B23t—30 to 46 inches, yellowish-brown (10YR 5/4) light clay loam; moderate, medium, subangular blocky structure; firm; clay films on some faces of peds; slightly acid; gradual, wavy boundary.

B3—46 to 62 inches, brown (10YR 5/3) loam; weak subangular blocky structure; firm; slightly acid; gradual, wavy boundary.

C—62 to 72 inches, brown (10YR 5/3) loam; massive; friable; mildly alkaline.

The solum is 44 to 66 inches thick. The Ap horizon is dark grayish brown (10YR 4/2) or dark brown (10YR 3/3 or 4/3). The Bt horizon ranges from medium acid to neutral.

Riddles soils are associated on the landscape with the well-drained Miami and Hillsdale soils and the somewhat poorly drained Crosier soils. Riddles soils have a thicker solum than Miami soils. They have a finer textured solum than Hillsdale soils. Riddles soils have a thicker solum than Crosier soils, and they are not mottled.

RtA—Riddles loam, 0 to 2 percent slopes. This soil is on broad flats in the uplands. The areas range from 2 to 80 acres but average 10 acres. This soil has a profile similar to the one described as representative of the series, but its surface layer and subsoil are thicker.

Included in mapping are areas, less than 2 acres in size, of nearly level, somewhat poorly drained Crosier soils and areas of soils that have a surface layer of sandy loam.

Most areas of this soil are used for cash-grain farming. The soil is well suited to most crops commonly grown in the county and has slight limitations for most nonfarm uses. Capability unit I-1; woodland group 1o1.

RtB—Riddles loam, 2 to 6 percent slopes. This soil is on knolls and long, irregular side slopes. The areas range from 2 to 100 acres but average 15 acres. This soil has the profile described as representative of the series.

Included in mapping are small areas of gently sloping, well-drained Miami soils and gently sloping, somewhat poorly drained Crosier soils. Also included are soils that have a surface layer of sandy loam.

Most areas of this soil are used for cash-grain farming. The soil is well suited to most crops commonly grown in the county if erosion is adequately controlled. It has slight or moderate limitations for most nonfarm uses. Capability unit IIe-1; woodland group 1o1.

RtC2—Riddles loam, 6 to 12 percent slopes, eroded. This soil is in irregularly shaped areas on narrow, elongated side slopes. The areas range from 2 to 50 acres but average 10 acres. This soil has a profile similar to the one described as representative of the series, but its surface layer is thinner and is mixed with some dark yellowish-brown clay loam from the subsoil.

Included in mapping are small areas of moderately sloping, well-drained Miami soils and soils that have a surface layer of sandy loam.

Erosion is the major concern in management.

Most areas of this soil are used for cash-grain farming. The soil is suited to most crops commonly grown in the county if erosion is adequately controlled. It has

moderate limitations for most nonfarm uses. Capability unit IIIe-1; woodland group 1o1.

RtD2—Riddles loam, 12 to 18 percent slopes, eroded. This soil is on narrow, elongated ridgetops and knolls along small streams and drainageways. The areas range from 2 to 20 acres but average 5 acres. This soil has a profile similar to the one described as representative of the series, but its surface layer and subsoil are thinner. Some dark yellowish-brown clay loam from the subsoil is mixed with the surface layer.

Included in mapping are small areas where slopes are 6 to 12 percent and small areas of Miami soils.

Erosion is the major concern in management.

Most areas of this soil are in permanent pasture. The soil is poorly suited to crops commonly grown in the county and has severe limitations for most nonfarm uses. Capability unit IVe–1; woodland group 1o1.

Tedrow Series

The Tedrow series consists of deep, somewhat poorly drained, nearly level soils on outwash plains. These soils are mainly on broad flats between higher, excessively drained soils and very poorly drained, sandy soils in depressions. They formed in sandy outwash. The native vegetation was mainly mixed hardwoods.

In a representative profile, the surface layer is dark grayish-brown fine sand about 7 inches thick. The subsurface layer is mottled, grayish-brown fine sand 3 inches thick. The subsoil is 40 inches thick. It is mottled yellowish-brown, light yellowish-brown, and light brownish-gray, friable sand in the upper 9 inches; mottled yellowish-brown and grayish-brown, friable sand in the next 15 inches; mottled, yellowish-brown, loose sand in the next 7 inches; and mottled, light yellowish-brown, loose sand in the lower 9 inches. The underlying material is light yellowish-brown sand that extends to a depth of 60 inches.

Tedrow soils have rapid permeability and a low available water capacity. The organic-matter content is moderate in the surface layer. Runoff is slow.

Representative profile of Tedrow fine sand, in a cultivated field, 80 feet south and 1,100 feet west of the NE corner of sec. 31, T. 38 N., R. 4 E.

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) fine sand; few, fine, distinct, light yellowish-brown (10YR 6/4) mottles; few, fine, dark grayish-brown (10YR 4/2) streaks; weak, fine, granular structure; very friable; slightly acid; clear, smooth boundary.

A2—7 to 10 inches, grayish-brown (10YR 5/2) fine sand; few, fine, distinct, light yellowish-brown (10YR 6/4) mottles; few, fine, dark grayish-brown (10YR 4/2) streaks; weak, fine, granular structure; friable; slightly acid; clear, smooth boundary.

B1—10 to 19 inches, mottled yellowish-brown (10YR 5/6), light yellowish-brown (10YR 6/4), and light brownish-gray (10YR 6/2) sand; moderate, fine, granular structure; friable; medium acid; clear, smooth boundary.

B21—19 to 34 inches, mottled yellowish-brown (10YR 5/6) and grayish-brown (10YR 5/2) sand; weak, fine, subangular blocky structure; friable; iron cementation of sand grains; medium acid; gradual, wavy boundary.

B22—34 to 41 inches, yellowish-brown (10YR 5/6) sand; common, medium, distinct, light-gray (10YR 6/1) mottles; single grained; loose; slightly acid; gradual, irregular boundary.

B3—41 to 50 inches, light yellowish-brown (10YR 6/4) fine sand; common, medium, distinct, strong-brown (7.5YR 5/6) mottles; iron cementation of sand grains; single grained; loose; neutral; gradual, wavy boundary.

C—50 to 60 inches, light yellowish-brown (10YR 6/4) sand; single grained; loose; neutral.

The solum is 24 to 54 inches thick. The Ap horizon is very dark grayish brown (10YR 3/2) or dark grayish brown (10YR 4/2). The Ap and A2 horizons are slightly acid or neutral. Iron stains that have a hue of 7.5YR or 5YR and value of 4 to 6 are common. The C horizon is yellowish brown (10YR 6/4 or 2.5Y 6/4).

Tedrow soils are associated on the landscape with the moderately well drained Brems soils, the somewhat poorly drained Brady soils, and the very poorly drained Maumee soils. Unlike Brems soils, Tedrow soils have grayish mottles in the upper part of the subsoil. They have a coarser textured solum than Brady soils. Tedrow soils do not have so gray a solum as Maumee soils.

Te—Tedrow fine sand. This soil is in irregularly shaped areas on broad flats. The areas range from 2 to 250 acres but average 30 acres. Slopes are 0 to 2 percent.

Included in mapping are areas, less than 2 acres in size, of nearly level, moderately well drained Brems soils and depressional, very poorly drained Maumee soils. Also included are soils that have a surface layer of loamy sand or loamy fine sand.

This soil has a seasonal high water table at a depth of 1 to 3 feet. Wetness is the major concern in management.

Most areas of this soil are used for cash-grain farming, but some are used for grass and legumes for forage. If it is adequately drained, the soil is suited to most crops commonly grown in the county, but it has moderate to severe limitations for most nonfarm uses. Capability unit IIIw-4; woodland group 3w20.

Tracy Series

The Tracy series consists of deep, well drained, nearly level to moderately sloping soils on outwash plains and terraces. The native vegetation was mainly mixed hardwoods.

In a representative profile, the surface layer is dark grayish-brown sandy loam about 9 inches thick. The subsoil is 33 inches thick. It is brown, firm loam in the upper 7 inches; dark-brown, firm loam in the next 6 inches; dark-brown, friable sandy loam in the next 5 inches; dark-brown, friable gravelly sandy loam in the next 5 inches; and dark-brown, friable gravelly loamy sand in the lower 10 inches. The underlying material is brown sand that extends to a depth of 60 inches.

Tracy soils have moderate permeability and a moderate available water capacity. The organic-matter content is high in the surface layer. Runoff is slow and medium.

Representative profile of Tracy sandy loam, 0 to 2 percent slopes, in a cultivated field, 2,300 feet west and 600 feet north of the SE corner of sec. 1, T. 37 N., R. 1 W.

Ap—0 to 9 inches, dark grayish-brown (10YR 4/2) sandy loam; weak, medium, granular structure; friable; slightly acid; abrupt, smooth boundary.

B1—9 to 16 inches, brown (10YR 5/3) loam; weak, medium, subangular blocky structure; firm; few, discontinuous, faint, thin, dark-brown (10YR 3/3) clay

films on faces of peds; slightly acid; clear, wavy boundary.

B21t—16 to 22 inches, dark-brown (7.5YR 4/4) loam; moderate, medium, subangular blocky structure; firm; common, discontinuous, distinct, thin, dark-brown (7.5YR 3/2) clay films on faces of peds; few fine pebbles 1/2 inch in diameter; medium acid; clear, wavy boundary.

B22t—22 to 27 inches, dark-brown (7.5YR 4/4) sandy loam; weak, medium, subangular blocky structure; friable; few, discontinuous, distinct, thin, dark-brown (7.5YR 3/2) clay films on faces of peds; few small shale fragments; strongly acid; clear, wavy boundary.

B23t—27 to 32 inches, dark-brown (7.5YR 4/4) gravelly sandy loam; weak, medium, subangular blocky structure; friable; few, patchy, faint, dark-brown (7.5YR 3/2) clay films on faces of peds; strongly acid; clear, wavy boundary.

IIB3—32 to 42 inches, dark-brown (7.5YR 4/4) gravelly loamy sand; weak, coarse, granular structure; friable; clay bridgings on sand grains and on faces of pebbles 1/2 inch in diameter; medium acid; abrupt, wavy boundary.

IIC—42 to 60 inches, brown (10YR 5/3) sand; loose; single grained; slightly acid.

The solum is 36 to 50 inches thick. The Ap horizon is dark grayish brown (10YR 4/2) or dark brown (10YR 4/3). It is slightly acid or medium acid. The Bt horizon ranges from slightly acid to strongly acid. These horizons contain 5 to 30 percent fine gravel and shale.

Tracy soils are associated on the landscape with the well-drained Coupee and Oshtemo soils. Tracy soils have a thinner and lighter colored A horizon than Coupee soils. Unlike Oshtemo soils, they have shale in the B horizon.

TrA—Tracy sandy loam, 0 to 2 percent slopes. This soil is in irregularly shaped areas on broad flats. The areas range from 2 to 160 acres but average 30 acres. This soil has the profile described as representative of the series.

Included in mapping are areas, less than 2 acres in size, of well-drained, nearly level Coupee and Oshtemo soils. Also included are soils that have a surface layer of loam.

Droughtiness is the major concern in management.

Most areas of this soil are used for cash-grain farming. The soil is suited to most crops commonly grown in the county and has slight limitations for most nonfarm uses. Capability unit IIs-5; woodland group 3s17.

TrB—Tracy sandy loam, 2 to 6 percent slopes. This soil is in irregularly shaped areas on broad flats. The areas range from 2 to 160 acres but average 10 acres. This soil has a profile similar to the one described as representative of the series, but its surface layer is thinner.

Included in mapping are areas, less than 2 acres in size, of gently sloping, well-drained Oshtemo sandy loam. Also included are soils that have a surface layer of dark-colored loam.

Erosion and droughtiness are major concerns in management.

Most areas of this soil are cultivated. The soil is suited to most crops commonly grown in the county. It has slight limitations for most nonfarm uses. Capability unit IIe-3; woodland group 3s17.

TrC2—Tracy sandy loam, 6 to 12 percent slopes, eroded. This soil is in elongated areas on knolls. The areas range from 2 to 60 acres but average 10 acres. Slopes are short. This soil has a profile similar to the one described as representative of the series, but its surface layer is thinner because of erosion. Some brown heavy loam from the subsoil is mixed with the surface layer.

Included in mapping are small areas of moderately sloping, well-drained Tyner loamy sand.

Erosion, droughtiness, and slope are the major concerns in management.

This soil is suited to small grain and grass and legumes for forage. Some areas are in row crops, but most are idle or are used for urban development. The soil has moderate limitations for most nonfarm uses. Capability unit IIIe-13; woodland group 3s17.

Troxel Series

The Troxel series consists of deep, well-drained depressional soils on outwash plains. These soils are mainly in depressions and shallow basins surrounded by well-drained soils. They formed in loamy material that was washed from adjacent narrow slopes and in the underlying loamy outwash. The native vegetation was prairie grass.

In a representative profile, the surface layer is very dark brown silt loam about 31 inches thick. The layer below that is 27 inches thick. It is black silt loam in the upper 11 inches; very dark brown silt loam in the next 10 inches; and very dark grayish-brown silt loam in the lower 6 inches. Beneath that is a layer 33 inches thick. It is dark yellowish-brown, firm light clay loam in the upper 12 inches; yellowish-brown, friable sandy loam in the next 10 inches; and grayish-brown, firm loam in the lower 11 inches.

Troxel soils have moderate permeability and a moderate available water capacity. The organic-matter content is high in the surface layer. Runoff is slow.

Representative profile of Troxel silt loam, in a cultivated field, 1,000 feet south and 420 feet east of the NW corner of NE¼ sec. 17, T. 38 N., R. 2 E.

Ap—0 to 8 inches, very dark brown (10YR 2/2) silt loam; moderate, medium and fine, granular structure; friable; common medium roots; medium acid; abrupt, smooth boundary.

A12—8 to 31 inches, very dark brown (10YR 2/2) silt loam, very dark grayish brown (10YR 3/2) crushed; weak, medium, prismatic structure parting to moderate, medium, subangular blocky; friable; common fine roots; common, fine, inped, tubular pores; strongly acid; gradual, wavy boundary.

IIA1b—31 to 42 inches, black (10YR 2/1) silt loam; strong, very fine, subangular blocky structure; friable; very dark brown (10YR 2/2) organic coatings on vertical faces of peds; common fine roots; common fine pores; strongly acid; gradual, smooth boundary.

IIA12b—42 to 52 inches, very dark brown (10YR 2/2) silt loam; weak, fine, prismatic structure; friable; few fine roots; common, fine, inped, tubular pores; strongly acid; clear, wavy boundary.

IIA3b—52 to 58 inches, very dark grayish-brown (10YR 3/2) silt loam; moderate, medium, subangular blocky structure; friable; strongly acid; clear, wavy boundary.

IIB21tb—58 to 70 inches, dark yellowish-brown (10YR 4/4) light clay loam; moderate, medium, subangular blocky structure; firm; thin, patchy, discontinuous, dark grayish-brown (10YR 4/2) clay films on faces of peds and in root channels; few worm casts; strongly acid; clear, wavy boundary.

IIB22b—70 to 80 inches, yellowish-brown (10YR 5/4) sandy loam; moderate, medium, subangular blocky struc-

ture; friable; few very fine roots; 5 percent shale fragments; medium acid; clear, wavy boundary.

IIB3b—80 to 91 inches, grayish-brown (10YR 5/2) loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; massive; firm; many very dark brown (10YR 2/2) stains in old root channels; 5 percent shale fragments; medium acid.

The solum is 48 to more than 90 inches thick. The Ap and A12 horizon are very dark brown (10YR 2/2) or black (10YR 2/1). The IIA1b horizon ranges from black (10YR 2/1) to very dark grayish brown (10YR 3/2). The IIB horizon is loam, clay loam, light clay loam, or sandy loam and is medium acid or strongly acid. The C horizon is loose sand.

Troxel soils formed in the same kind of material and are associated on the landscape with the well-drained Coupee and Tracy soils. Troxel soils have a thicker A horizon than those soils.

Tx—Troxel silt loam. This soil is in slightly depressed, oval-shaped basins along drainageways. The areas range from 2 to 50 acres but average 4 acres. Slopes are 0 to 2 percent.

Included in mapping are areas, less than 2 acres in size, of nearly level and gently sloping, well-drained Coupee and Tracy soils. Also included are soils that have a surface layer of loam.

This soil is used for corn and soybeans. It is well suited to all crops commonly grown in the county and to grasses and legumes for forage. The soil has slight limitations for most nonfarm uses. Capability unit I-1; woodland group o23.

Tyner Series

The Tyner series consists of deep, well-drained, nearly level to strongly sloping soils on outwash plains and terraces. These soils are mainly on raised flats and ridges. They formed in sandy outwash. The native vegetation was mainly mixed hardwoods.

In a representative profile, the surface layer is dark-brown loamy sand about 9 inches thick. The subsoil is 35 inches thick. It is dark yellowish-brown, very friable loamy sand in the upper 16 inches and dark-brown, very friable loamy sand in the lower 19 inches. The underlying material extends to a depth of 70 inches. It is yellowish-brown sand in the upper 16 inches and dark-brown sand in the lower 10 inches.

Tyner soils have rapid permeability and a low available water capacity. The organic-matter content is moderate in the surface layer. Runoff is slow or medium.

Representative profile of Tyner loamy sand, 0 to 6 percent slopes, in a cultivated field, 500 feet east and 120 feet north of SW corner of SE¼ sec. 27, T. 38 N., R. 3 E.

Ap—0 to 9 inches, dark-brown (10YR 3/3) loamy sand, pale brown (10YR 6/3) dry; weak, fine, granular structure; very friable; strongly acid; abrupt, smooth boundary.

B21—9 to 25 inches, dark yellowish-brown (10YR 4/4) loamy sand; weak, fine, subangular blocky structure; very friable; 5 percent rounded pebbles and shale fragments; strongly acid; clear, wavy boundary.

B22—25 to 44 inches, dark-brown (7.5YR 4/4) loamy sand; weak, medium, subangular blocky structure; very friable; 5 percent rounded pebbles and shale fragments; strongly acid; clear, wavy boundary.

C1—44 to 60 inches, yellowish-brown (10YR 5/6) sand; single grained; loose; many sand-sized shale fragments; strongly acid; clear, wavy boundary.

C2—60 to 70 inches, dark-brown (10YR 3/4) sand; single grained; loose; many sand-sized shale fragments; medium acid.

The solum is 36 to 60 inches thick. The Ap or A1 horizon is dark brown (10YR 3/3) or brown (10YR 4/3). It is slightly acid to strongly acid. The B22 horizon is loamy sand or sand. The C1 and C2 horizons are medium acid or strongly acid.

Tyner soils are associated on the landscape with the excessively drained Chelsea soils, the well-drained Oshtemo soils, and the moderately well-drained Brems soils. Tyner soils have a finer textured solum than Chelsea soils, and they lack bands. They have a coarser textured solum than Oshtemo soils. Unlike Brems soils, Tyner soils are not mottled.

TyA—Tyner loamy sand, 0 to 6 percent slopes. This soil is in irregularly shaped areas on broad flats. The areas range from 2 to 3,600 acres but average 120 acres. This soil has the profile described as representative of the series.

Included in mapping are areas, less than 2 acres in size, of nearly level, well-drained Oshtemo soils and nearly level, moderately well drained Brems soils.

Droughtiness is the major concern in management. Soil blowing is a hazard when the soil is dry if it has no protective cover.

Most areas of this soil are used for urban development. Some are used for cash-grain farming, but the soil is not well suited to this use. The soil has slight limitations for most nonfarm uses. Capability unit IIIs-1; woodland group 3s17.

TyC—Tyner loamy sand, 6 to 12 percent slopes. This soil is in elongated areas that range from 2 to 70 acres but average 10 acres. Slopes are short. This soil has a profile similar to the one described as representative of the series, but because of erosion, its surface layer is thinner and is mixed with some dark yellowish-brown material from the subsoil.

Included in mapping are areas, less than 2 acres in size, of moderately sloping, well-drained Oshtemo soils and soils that have slopes of less than 6 percent.

Droughtiness and slope are the major concerns in management. Soil blowing is a hazard when the soil is dry if it has no protective cover.

Most areas of this soil are used for urban development, but a few are used for cash-grain farming. The soil has moderate limitations for most nonfarm uses. Capability unit IVe-12; woodland group 3s17.

TyD—Tyner loamy sand, 12 to 18 percent slopes. This soil is in elongated areas on low ridges on outwash flats. The areas range from 2 to 80 acres but average 8 acres. Slopes are short. This soil has a profile similar to the one described as representative of the series, but its surface layer is thinner, and it is shallower to the underlying material. Some dark yellowish-brown material from the subsoil is mixed with the surface layer.

Included in mapping are areas, less than 2 acres in size, of strongly sloping, well-drained Oshtemo soils and soils that have slopes of more than 18 percent.

Droughtiness and slope are the major concerns in management.

Most areas of this soil are in woodland along the St. Joseph River. Because of slope, the soil has severe

limitations for most crops and for most nonfarm uses. Capability unit VIe-12; woodland group 3s17.

Wallkill Series

The Wallkill series consists of deep, very poorly drained, nearly level and depressional soils on flats on till plains and lake plains. These soils are mainly in potholes between gently sloping soils and strongly sloping soils in the uplands and on terraces. They formed in recent alluvium over muck. The native vegetation was water-tolerant grass, sedges, and hardwoods.

In a representative profile, the surface layer is very dark grayish-brown silt loam about 7 inches thick. The layer below that is grayish-brown loam in the upper 5 inches; pale-brown sandy loam in the next 4 inches; and dark grayish-brown silt loam in the lower 16 inches. Beneath this is black muck that extends to a depth of 60 inches or more.

Wallkill soils have moderate permeability and a high available water capacity. The organic-matter content is high in the surface layer. Runoff is very slow or ponded.

Representative profile of Wallkill silt loam, in a cultivated field, 420 feet west and 200 feet north of SE corner of the SW¼ sec. 29, T. 36 N., R. 3 E.

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) silt loam; weak, medium, granular structure; friable; medium acid; clear, wavy boundary.

C1—7 to 12 inches, grayish-brown (10YR 5/2) loam; weak, medium, subangular blocky structure; friable; medium acid; clear, wavy boundary.

C2—12 to 16 inches, pale-brown (10YR 6/3) sandy loam; weak, fine and medium, subangular blocky structure; friable; few, fine, distinct, very dark grayish-brown (10YR 3/2) streaks; slightly acid; clear, wavy boundary.

C3—16 to 32 inches, dark grayish-brown (10YR 4/2) silt loam; weak, medium, subangular blocky structure; firm; slightly acid; abrupt, smooth boundary.

IIOa1—32 to 40 inches, black (10YR 2/1) sapric material, broken face and rubbed; about 35 percent fiber, 5 percent rubbed; weak, medium, subangular blocky structure; firm; mineral content 10 percent, slightly acid; gradual, wavy boundary.

IIOa2—40 to 60 inches, black (10YR 2/1) sapric material, broken face and rubbed; about 40 percent fiber, 10 percent rubbed; weak, medium, subangular blocky structure; friable; mineral content 5 percent; slightly acid.

The mineral overwash is 16 to 40 inches thick. The Ap horizon is very dark brown (10YR 2/2) or very dark grayish-brown (10YR 3/2) silt loam. The C1, C2, and C3 horizon are silt loam, loam, or sandy loam and range from dark grayish brown (10YR 4/2) to light brownish gray (10YR 6/2) or pale brown (10YR 6/3).

Wallkill soils are associated on the landscape with the very poorly drained Houghton, Palms, and Adrian soils. Unlike those soils, Wallkill soils have 16 to 40 inches of mineral overwash above the organic material.

Wk—Wallkill silt loam. This soil is in irregularly shaped areas in narrow depressions and in potholes. The areas range from 2 to 30 acres but average 5 acres. Slopes are 0 to 2 percent.

Included in mapping are small areas of depressional, very poorly drained Houghton, Palms, and Adrian soils.

This soil has a seasonal high water table within 1 foot of the surface. Wetness is the major concern in management.

Most areas of this soil are used for cash-grain farming. If it is adequately drained, the soil is well suited to most crops commonly grown in the county, but it has severe limitations for most non-farm uses. Capability unit IIw-7; woodland group 4w23.

Washtenaw Series

The Washtenaw series consists of deep, very poorly drained soils on till plains and outwash plains. These soils are mainly in depressions parallel to streams and adjacent to gently sloping and strongly sloping soils on the uplands. They formed in recent alluvium and the underlying loamy till or loamy outwash. The native vegetation was mainly water-tolerant hardwoods.

In a representative profile, the surface layer is mottled, dark grayish-brown silt loam about 7 inches thick. It is underlain by grayish-brown and gray silt loam 16 inches thick. Beneath this is a buried soil. The upper layer of the buried soil is very dark gray light silty clay loam 5 inches thick. The buried subsoil is 28 inches thick. It is mottled, gray, firm silty clay loam in the upper 20 inches and mottled, light-gray, firm heavy silt loam in the lower 8 inches. The underlying material is mottled, light-gray loam that extends to a depth of 60 inches.

Washtenaw soils have slow permeability and a high available water capacity. The organic-matter content is moderate in the surface layer. Runoff is very slow or ponded.

Representative profile of Washtenaw silt loam, in an open field, 560 feet west and 600 feet south of the NE corner of NW¼ sec. 4, T. 36 N., R. 2 E.

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) silt loam; common, fine, distinct, brown (10YR 5/3) mottles; moderate, fine, granular structure; friable; slightly acid; clear, smooth boundary.

C1—7 to 15 inches, grayish-brown (10YR 5/2) silt loam; common, medium, distinct, brown (10YR 5/3) mottles; moderate, fine, subangular blocky structure; friable; slightly acid; clear, wavy boundary.

C2—15 to 23 inches, gray (10YR 5/1) silt loam; common, medium, distinct, dark-brown (7.5YR 3/2) mottles; weak, medium, subangular blocky structure; friable; neutral; clear, wavy boundary.

IIA1b—23 to 28 inches, very dark gray (10YR 3/1) light silty clay loam; moderate, medium, subangular blocky structure; firm; few, fine, faint, gray (10YR 5/1) silt coatings; neutral; clear, wavy boundary.

IIB21tgb—28 to 48 inches, gray (10YR 5/1) silty clay loam; common, medium and fine, distinct dark yellowish-brown (10YR 4/4) mottles; moderate, coarse, prismatic structure; firm; neutral; gradual, wavy boundary.

IIB22tgb—48 to 56 inches, light-gray (5Y 6/1) heavy silt loam; moderate, coarse, prominent, yellowish-brown (10YR 5/6) mottles; moderate, coarse, prismatic structure; firm; neutral; clear, wavy boundary.

IIC—56 to 60 inches, light-gray (5Y 6/1) loam; few, medium, distinct, brown (10YR 5/3) and yellowish-brown (10YR 5/6) mottles; massive; friable; strongly effervescent; moderately alkaline.

The overwash is 20 to 40 inches thick, and the buried soil is 24 to 40 inches thick. The Ap horizon is dark gray (10YR 4/1), dark grayish brown (10YR 4/2), or grayish brown (10YR 5/2). It is neutral or slightly acid. The IIBtgb horizon ranges from loam to silty clay loam till or outwash sand and gravelly sand.

Washtenaw soils are associated on the landscape with the very poorly drained Brookston and Rensselaer soils. Unlike

those soils, Washtenaw soils have 20 to 40 inches of recent overwash above a buried soil.

Ws—Washtenaw silt loam. This soil is in elongated and irregularly shaped areas in narrow drainageways. The areas range from 2 to 20 acres but average 5 acres. Slopes are 0 to 2 percent.

Included in mapping are small areas of depressional, very poorly drained Brookston and Rensselaer soils and nearly level, somewhat poorly drained Crosier soils.

This soil has a seasonal high water table within 1 foot of the surface. Wetness is the major concern in management.

Most areas of this soil are used for cash-grain farming. The soil is well suited to cultivated crops if it is adequately drained, but it has severe limitations for most nonfarm uses. Capability unit IIw-1; woodland group 2w11.

Whitaker Series

The Whitaker series consists of deep, somewhat poorly drained, nearly level soils on outwash plains. These soils are mainly on broad flats between higher, gently sloping soils and soils in depressions. They formed in stratified loamy and sandy material. The native vegetation was mixed hardwoods.

In a representative profile, the surface layer is dark grayish-brown loam about 8 inches thick. The subsurface layer is mottled, pale-brown light loam 3 inches thick. The subsoil is 33 inches thick. It is mottled, pale-brown, friable light clay loam and light brownish-gray silt loam in the upper 3 inches; mottled, yellowish-brown, firm clay loam in the next 14 inches; and mottled, light brownish-gray, firm clay loam in the lower 16 inches. The underlying material is mottled, brownish-yellow, stratified silt and sand that extends to a depth of 60 inches.

Whitaker soils have moderate permeability and a high available water capacity. The organic-matter content is moderate in the surface layer. Runoff is slow.

Representative profile of Whitaker loam, in a cultivated field, 700 feet north and 1,000 feet west of the SE corner of NE¼ sec. 6, T. 36 N., R. 3 E.

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) loam; moderate, fine, granular structure; friable; mixed with some pale-brown (10YR 6/3) material; medium acid; abrupt, smooth boundary.

A2—8 to 11 inches, pale-brown (10YR 6/3) light loam; common, medium, faint, light-gray (2.5Y 7/2) mottles and few, fine, distinct, brownish-yellow (10YR 6/6) mottles; weak, thick, platy structure; friable; few, fine, dark concretions (iron and manganese oxides); few dark grayish-brown (10YR 4/2) channel fillings; medium acid; clear, wavy boundary.

B&A—11 to 14 inches, pale-brown (10YR 6/3) light clay loam (B part); many, medium, distinct, brownish-yellow (10YR 6/6) mottles; weak, medium, subangular blocky structure; friable; light brownish-gray (2.5Y 6/2) silt loam (A part); few dark-gray (10YR 4/1) channel fillings; few, fine, dark concretions (iron and manganese oxides); medium acid; clear, wavy boundary.

B21t—14 to 28 inches, yellowish-brown (10YR 5/6) clay loam; many, fine, faint, light brownish-gray (10YR 6/2) mottles and common, fine, faint, strong-brown (7.5YR 5/8) mottles; weak, medium, prismatic structure parting to moderate, medium, subangular blocky; firm; 2 percent small pebbles; few, small, dark concretions (iron and manganese oxides); many, distinct, continuous, thin light-gray (2.5Y 7/2) clay films on vertical faces of peds; medium acid; clear, wavy boundary.

B22t—28 to 34 inches, light brownish-gray (10YR 6/2) clay loam; many, fine, faint, pale-brown (10YR 6/3) and strong-brown (7.5YR 5/6) mottles; moderate, coarse, subangular blocky structure; firm; grayish-brown (2.5Y 5/2), discontinuous clay films on vertical and horizontal faces of peds; pockets of brown (10YR 4/3) sandy loam in upper 2 inches of horizon; few, small, dark, soft, rounded masses (iron and manganese oxides); slightly acid; clear, wavy boundary.

B3—34 to 44 inches, light brownish-gray (10YR 6/2) clay loam; many, coarse, distinct, strong-brown (7.5YR 5/6) mottles and many, medium, faint, pale-brown (10YR 6/3) mottles; thin stratified layers of fine sand, silt, and clay; weak, medium, subangular blocky structure; firm; few, fine, dark concretions (iron and manganese oxides); medium acid; clear, wavy boundary.

C—44 to 60 inches, brownish-yellow (10YR 6/6) stratified silt and sand; many, medium, distinct, light brownish-gray (2.5Y 6/2) mottles; massive in silt strata and single grained in sand strata; friable; slightly acid.

The solum is 36 to 60 inches thick. The Ap or A1 horizon has a hue of 10YR, value of 4 to 6, and chroma of 1 to 3. It is neutral to medium acid. The A2 horizon is light brownish gray (10YR 6/2), grayish brown (10YR 5/2), or pale brown (10YR 6/3). The B horizon is pale brown (10YR 6/3), yellowish brown (10YR 5/6), or light brownish gray (10YR 6/2) and is clay loam, light clay loam, or heavy loam. It is medium acid or slightly acid. The C horizon in some profiles has thin layers of clay.

Whitaker soils are associated on the landscape with the well-drained Martinsville soils, the somewhat poorly drained Crosier soils, and the very poorly drained Rensselaer soils. Whitaker soils are mottled but Martinsville soils are not. Unlike Crosier soils, they are underlain by stratified silt and sand. Whitaker soils do not have so gray a B horizon as Rensselaer soils.

Wt—Whitaker loam. This soil is in irregularly shaped areas on broad flats. The areas range from 2 to 90 acres but average 20 acres. Slopes are 0 to 2 percent.

Included in mapping are areas, less than 2 acres in size, of gently sloping, well-drained Martinsville soils, nearly level, somewhat poorly drained Crosier soils, and depressional, very poorly drained Rensselaer soils.

The soil has a seasonal high water table at a depth of 1 to 3 feet. Wetness is the major concern in management.

Most areas of this soil are used for cash-grain farming. The soil is well suited to cultivated crops if it is adequately drained. It has moderate and severe limitations for most nonfarm uses. Capability unit IIw-2; woodland group 3w5.

Use and Management of the Soils

This section gives information on the use and management of the soils in St. Joseph County for cultivated crops and forage and for special crops and lists predicted yields of important crops. It also discusses the use of the soils for woodland, wildlife habitat, engineering structures and practices, town and country planning, trees and shrubs, and recreation facilities.

Specific management for individual soils is not suggested in this section. Detailed information on use and management can be provided by the local district

conservationist of the Soil Conservation Service or by the St. Joseph County Cooperative Extenstion Service.

Use of the Soils for Crops

About 65 percent of St. Joseph County is used for crops and pasture. The main crops are corn, soybeans, small grain, and grasses and legumes for forage. A small acreage is used for special crops, including mint, potatoes, onions, and other vegetables.

Some of the major management concerns in this county are controlling wetness, soil blowing, and water erosion, maintaining the fertility and organic-matter content, and maintaining or improving tilth. Of the intensively cultivated acreage, about 60 percent is limited by wetness and 7 percent by the hazard of erosion.

The management practices most needed are installing suitable tile drainage systems, grassing waterways, farming on the contour, using diversion terraces, grade stabilizing, minimum tillage, and using crop residue, green-manure crops, and winter cover crops.

Capability grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The groups are made according to the limitations of the soils when used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to cranberries, horticultural crops, or other crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for wildlife habitat, for forest trees, or for engineering.

In the capability system, all kinds of soils are grouped at three levels: the capability class, subclass, and unit. These are discussed in the following paragraphs:

CAPABILITY CLASSES, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture or range, woodland, or wildlife habitat.

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife habitat.

Class VII soils have severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife habitat.

Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife habitat, or water supply or to esthetic purposes. (None in St. Joseph County.)

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless a close-growing plant cover is maintrained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, hay, woodland, wildlife habitat, or recreation.

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-4 or IIIe-6.

Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass or kind of limitation as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

Capability unit numbers are generally assigned locally but are part of a statewide system. The capability unit numbers in this soil survey are not consecutive because not all of the capability units in the system are represented in St. Joseph County.

Management by capability units

In the following pages each capability unit in St. Joseph County is described and management for each is discussed. To find the capability unit of a specific soil, refer to the "Guide to Mapping Units" at the back of the survey.

Made land and Gravel pits have not been placed in a capability unit because they are so variable.

CAPABILITY UNIT I-1

This unit consists of deep, depressional and nearly level, well-drained soils. These soils are on glacial till plains, outwash plains, and terraces. They have a medium-textured surface layer and a moderately fine textured subsoil.

Soils in this unit have moderate permeability and a moderate or high available water capacity. The organic-matter content is high or moderate. There is little or no hazard of erosion, and surface runoff is slow.

Soils in this unit are easy to cultivate and respond well to good management. The major management practices needed are minimum tillage and using crop residue and winter cover crops to maintain good tilth.

These soils are suited to the crops commonly grown in the county, mainly corn, soybeans, small grain, and legume-grass mixtures. And they are suited to many kinds of cropping systems.

CAPABILITY UNIT IIe-1

This unit consists of deep, gently sloping, well-drained soils. These soils are on till plains. They have a medium-textured surface layer and a moderately fine textured subsoil.

Soils in this unit have moderate permeability and a high available water capacity. The organic-matter content in the surface layer is moderate. The hazard of erosion is moderate, and surface runoff is medium.

These soils are easy to cultivate and respond well to good management. The major management concerns are controlling erosion, maintaining fertility, and improving the tilth and organic-matter content. Contour farming, stripcropping, minimum tillage, and terracing help control erosion. Using crop residue and green-manure crops helps improve and maintain the organic-matter content, fertility, and tilth.

These soils are suited to all crops commonly grown in the county, particularly corn, soybeans, and small grain, if erosion is adequately controlled.

CAPABILITY UNIT IIe-3

This unit consists of deep, gently sloping, well-drained soils. These soils are on till plains, outwash plains, and terraces. They have a medium-textured or moderately coarse textured surface layer and a medium-textured or moderately fine textured subsoil.

Soils in this unit have moderate permeability and a moderate or high available water capacity. The organic-matter content in the surface layer is moderate. The hazard of erosion is moderate, and surface runoff is medium.

These soils are easy to manage and cultivate. The major management concerns are controlling erosion, maintaining the fertility and organic-matter content, and improving tilth. Contour farming, stripcropping, minimum tillage, and terracing help control erosion. Using crop residue and green-manure crops helps improve and maintain the organic-matter content, fertility, and tilth.

These soils are suited to the crops commonly grown in the county, mainly corn, soybeans, small grain, and legume-grass mixtures.

CAPABILITY UNIT IIe-6

Morley silt loam, 2 to 6 percent slopes, eroded, is the only soil in this unit. It is a deep, gently sloping, well drained and moderately well drained soil on till plains and moraines.

This soil has slow permeability and a high available water capacity. The organic-matter content is moderate in the surface layer. Surface runoff is medium.

The soil in this unit is easy to manage and cultivate. The major management concerns are controlling erosion, maintaining the fertility and organic-matter content, and improving tilth. Contour farming, stripcropping, minimum tillage, and terracing help control erosion. Using crop residue and green-manure crops helps improve and maintain the organic-matter content, fertility, and tilth.

This soil is suited to crops commonly grown in the county, if erosion is adequately controlled. The main crops are corn, soybeans, small grain, and legume-grass mixtures.

CAPABILITY UNIT IIe-11

Hillsdale sandy loam, 2 to 6 percent slopes, is the only soil in this unit. It is a deep, gently sloping, well-drained soil. It has a moderately coarse textured surface layer and a moderately fine textured subsoil.

This soil has moderate permeability and a moderate available water capacity. The organic-matter content is moderate in the surface layer. Surface runoff is medium.

The soil in this unit responds well to good management. The major management concerns are controlling erosion and maintaining the organic-matter content, fertility, and tilth. Contour farming, stripcropping, minimum tillage, and terracing help control erosion. Using crop residue and green-manure crops helps improve and maintain the organic-matter content, fertility, and tilth.

This soil is suited to most crops commonly grown in the county, mainly corn, soybeans, small grain, and legume-grass mixtures.

CAPABILITY UNIT IIw-1

This unit consists of deep, depressional to nearly level, very poorly drained and poorly drained soils. These soils have a moderately fine textured or medium-textured surface layer and a moderately fine textured subsoil.

Soils in this unit have slow permeability and a high available water capacity. The organic-matter content in the surface layer is moderate or high. Surface runoff is very slow or ponded (fig. 12).

The major management concerns are wetness, surface crusting, and inadequate aeration in the subsoil. When these soils are adequately drained they dry out and warm up early enough in spring for plowing and planting. Where they are practical to build and maintain, diversion terraces can divert surface runoff from adjacent uplands. To prevent puddling and maintain

Figure 12.—Ponding on Brookston silty clay loam causes severe damage to crops. This soil is in capablity unit IIw–1.

permeability, these soils should not be worked when wet. Minimum tillage and using crop residue and winter cover crops help prevent crusting of the surface and improve tilth.

The soils in this unit are well suited to corn, soybeans, and small grain if they are adequately drained. Many kinds of cropping systems are suitable, including continuous corn production.

CAPABILITY UNIT IIw-2

This unit consists of deep, nearly level and gently sloping, somewhat poorly drained soils. These soils are on lake plains, outwash plains, and till plains. They have a medium-textured surface layer and a moderately fine textured subsoil.

Soils in this unit have moderate to slow permeability and a high or moderate available water capacity. The organic-matter content in the surface layer ranges from low to high. There is little or no hazard of erosion, and surface runoff is slow on the nearly level soils. The surface crusts if the soils are tilled when wet.

The major management concerns are wetness and maintaining the organic-matter content and fertility, controlling erosion on the gently sloping soils, and preventing crusting of the surface. Minimum tillage and using crop residue and winter cover crops help prevent surface crusting, control erosion, and maintain the organic-matter content. The soils, when adequately drained, dry out and warm up early enough in the spring for plowing and planting.

These soils are suited to most crops commonly grown in the county, particularly to corn, soybeans, and small grain. They can support continuous row crops if they are drained and erosion is controlled.

CAPABILITY UNIT IIw-4

Gilford sandy loam is the only soil in this unit. It is a deep, nearly level, very poorly drained soil. It has a moderately coarse textured surface layer and a moderately coarse textured or moderately fine textured subsoil.

This soil has moderately rapid permeability and a moderate available water capacity. The organic-matter content is high in the surface layer. There is little or no hazard of erosion, and surface runoff is very slow or ponded.

The major management concerns are wetness and soil blowing. An adequate drainage system is necessary if the soil is used for crops.

This soil is suited to most crops in the county, mainly corn, soybeans, and small grain. Some specialty crops are also produced, mainly onions, potatoes, and radishes. Many low, depressional areas of this soil are dug out for ponds (fig. 13).

CAPABILITY UNIT IIw-7

Wallkill silt loam is the only soil in this unit. It is a deep, depressional to nearly level, very poorly drained soil on till plains and lake plains. It has 16 to 40 inches of medium-textured or moderately coarse textured mineral overwash over organic material.

This soil has moderate permeability and a high available water capacity. The organic-matter content is high in the surface layer and very high in the subsoil. There is little or no hazard of erosion, and surface runoff is very slow or ponded.

The major management concern is wetness. A suitable drainage system is needed to remove excess water. Diversions should be constructed to intercept water that accumulates from adjacent uplands.

This soil occurs in such small areas that it is generally farmed in the same way as adjoining soils.

CAPABILITY UNIT IIw-10

Palms muck, drained, is the only soil in this unit. It is a depressional to nearly level, very poorly drained soil on lake plains.

This soil has rapid permeability in the organic layer and moderately slow permeability in the underlying mineral layer. It has a high available water capacity. The organic-matter content is very high. Surface run-

Figure 13.—This pond is on Rensselaer loam.

off is very slow or ponded. This soil is highly susceptible to blowing if it is not protected by a windbreak or plant cover.

The major management concerns are wetness and soil blowing. A suitable drainage system is needed to remove excess water.

This soil is suited to most crops commonly grown in the county, mainly corn, soybeans, and small grain. It is well suited to special crops, such as tomatoes, onions, cabbage, carrots, potatoes, and mint.

CAPABILITY UNIT IIw-11

Aubbeenaubbee sandy loam is the only soil in this unit. It is a deep, nearly level, somewhat poorly drained soil. It has a moderately coarse textured surface layer and moderately fine textured subsoil.

This soil has moderately slow permeability and a moderate available water capacity. The organic-matter content is moderate in the surface layer. There is little or no hazard of erosion, and surface runoff is slow.

The major management concerns are wetness and maintaining the organic-matter content and fertility.

Using crop residue and minimum tillage help maintain and improve the organic-matter content and fertility. An adequate drainage system is necessary to remove excess water that accumulates during periods of prolonged rainfall.

This soil is suited to most crops commonly grown in the county, particularly corn, soybeans, and small grain, if it is adequately drained.

CAPABILITY UNIT IIs-1

Fox sandy loam, 0 to 2 percent slopes, is the only soil in this unit. It is a nearly level, well-drained soil on glacial outwash. It has a moderately coarse textured surface layer and a moderately fine textured subsoil. It is moderately deep to deep to sand and gravel or sand.

This soil has moderate or moderately rapid permeability and a moderate available water capacity. The organic-matter content is moderate or high in the surface layer. There is little or no hazard of erosion, and surface runoff is slow.

This soil is easy to cultivate and manage. The major management concern is droughtiness during extended dry periods. Using crop residue and green-manure crops and minimum tillage help improve and maintain the available water capacity.

This soil is suited to the crops commonly grown in the county, mainly corn, soybeans, small grain, and grass-legume mixtures.

CAPABILITY UNIT IIs-2

This unit consists of deep, nearly level, well-drained soils. These soils are on outwash plains.

Soils in this unit have moderate permeability and a moderate available water capacity. The organic-matter content is high in the surface layer. There is little or no hazard of erosion, and runoff is slow.

These soils are easy to cultivate and manage. The major management concern is droughtiness during extended dry periods. Using crop residue and green-

manure crops and minimum tillage help improve and maintain the available water capacity.

Soils in this unit are suited to all crops commonly grown in the county. The main crops are corn, soybeans, small grain, and grass-legume mixtures.

CAPABILITY UNIT IIs-5

This unit consists of deep, nearly level, well-drained soils. These soils are on till plains, outwash plains, and moraines. They have a medium-textured and moderately coarse textured surface layer and a moderately fine textured and moderately coarse textured subsoil.

Soils in this unit have moderate permeability and a moderate available water capacity. The organic-matter content is moderate and high in the surface layer. There is little or no hazard of erosion, and surface runoff is slow.

These soils are easy to cultivate and respond well to good management. The major management concerns are maintaining the organic-matter content, fertility, and tilth. Droughtiness is a major concern during extended dry periods.

Using winter cover crops, crop residue, and green-manure crops and minimum tillage help improve and maintain the organic-matter content, fertility, tilth, and available water capacity.

Soils in this unit are suited to all crops commonly grown in the county. The main crops are corn, soybeans, and small grain.

CAPABILITY UNIT IIs-7

Landes loam is the only soil in this unit. It is a moderately well drained, nearly level soil on bottom lands. This soil has a medium-textured surface layer and medium-textured or moderately coarse textured underlying material.

This soil has moderately rapid or rapid permeability and a moderate available water capacity. The organic-matter content is high. There is little or no hazard of erosion, and surface runoff is slow. The soil is subject to flooding and tends to be droughty.

This soil is easy to cultivate and responds well to good management. The major management concerns are maintaining the organic-matter content and tilth. Using winter cover crops, crop residue, and green-manure crops and minimum tillage help improve and maintain the organic-matter content, fertility, tilth, and available water capacity.

This soil is suited to most crops commonly grown in the county. The main crops are corn, soybeans, small grain, and grasses and legumes for forage.

CAPABILITY UNIT IIIe-1

This unit consists of deep, moderately sloping, well drained and moderately well drained, eroded soils. These soils are on uplands. They have a medium-textured surface layer and a moderately fine textured subsoil.

Soils in this unit have moderate permeability and a high available water capacity. The organic-matter content is moderate in the surface layer. Surface runoff is medium.

The major management concerns are maintaining the organic-matter content and fertility, improving and maintaining good tilth, and controlling erosion. Minimum tillage, contour farming, and terracing help control erosion and runoff. Using crop residue and green-manure crops helps improve and maintain the organic-matter content, fertility, and tilth.

These soils are suited to corn, soybeans, and small grain if erosion is adequately controlled.

CAPABILITY UNIT IIIe-6

Morley silt loam, 6 to 12 percent slopes, eroded, is the only soil in this unit. It is a deep, gently sloping, well drained and moderately well drained soil on till plains and moraines. It has a medium-textured surface layer and a moderately fine textured subsoil.

This soil has slow permeability and a high available water capacity. The organic-matter content is moderate in the surface layer. Surface runoff is medium.

The major management concerns are maintaining the organic-matter content and fertility, improving and maintaining good tilth, and controlling erosion.

Minimum tillage, contour farming, and terracing help control erosion and runoff. Using crop residue and green-manure crops helps improve and maintain the organic-matter content, fertility, and tilth.

This soil is suited to corn, soybeans, and small grain if erosion is adequately controlled.

CAPABILITY UNIT IIIe-9

Fox sandy loam, 2 to 6 percent slopes, is the only soil in this unit. It is a well drained, gently sloping, slightly eroded soil on outwash terraces. It is moderately deep to sand and gravel.

This soil has moderately rapid permeability and a moderate available water capacity. The organic-matter content is moderate in the surface layer. Surface runoff is medium. This soil becomes droughty during extended dry periods.

The major management concerns are maintaining the organic-matter content and fertility, improving and maintaining good tilth, and controlling erosion. Using crop residue and green-manure crops helps improve and maintain the organic-matter content, fertility, and tilth. Minimum tillage, contour farming, and terracing help control erosion.

This soil is suited to corn, soybeans, and small grain if erosion is adequately controlled.

CAPABILITY UNIT IIIe-12

Chelsea fine sand, 5 to 10 percent slopes, is the only soil in this unit. It is a gently sloping and moderately sloping, excessively drained soil on outwash plains. It is coarse textured throughout.

This soil has rapid permeability and a low available water capacity. The organic-matter content is moderate in the surface layer. Surface runoff is medium. This soil is droughty during prolonged dry periods.

The major management concerns are maintaining the organic-matter content and fertility and preventing soil blowing. Using crop residue and green-manure crops helps improve and maintain the organic-matter content, fertility, and available water capacity. The

soil should have a continuous cover of vegetation to control soil blowing.

This soil is poorly suited to corn, soybeans, or small grain.

CAPABLITY UNIT IIIe-13

This unit consists of deep, gently sloping and moderately sloping, well-drained, eroded soils. These soils have a coarse textured and moderately coarse textured surface layer and a coarse-textured to moderately fine textured subsoil.

Soils in this unit have moderate to rapid permeability and a low to moderate available water capacity. The organic-matter content is moderate to high in the surface layer. Surface runoff is medium or slow. These soils are droughty during dry periods and are subject to soil blowing.

The major management concerns are maintaining the organic-matter content and fertility, improving and maintaining good tilth, and controlling erosion. Minimum tillage, contour farming, and terracing help control erosion and runoff. Using crop residue and green-manure crops helps improve and maintain the organic-matter content, fertility, and tilth. These practices also help reduce soil blowing and conserve soil moisture.

These soils are suited to corn, soybeans, and small grain if erosion is adequately controlled.

CAPABILITY UNIT IIIe-15

Hillsdale complex, 6 to 12 percent slopes, eroded, is the only mapping unit in this capability unit. It consists of deep, moderately sloping, well-drained soils on till plains and moraines. These soils have a moderately coarse textured surface layer and a moderately coarse textured to moderately fine textured subsoil.

Soils in this unit have moderate permeability and a moderate available water capacity. The organic-matter content is moderate in the surface layer. Surface runoff is medium.

The major management concerns are improving and maintaining the organic-matter content and fertility and controlling erosion and runoff.

Using crop residue and green-manure crops helps improve and maintain the organic-matter content and fertility. Minimum tillage, contour farming, and terracing help control erosion.

These soils are suited to corn, soybeans and small grain if erosion is adequately controlled. They are also suited to grasses and legumes.

CAPABILITY UNIT IIIw-1

This unit consists of deep, depressional to nearly level, very poorly drained soils. These soils are on outwash flats. They are coarse textured throughout.

Soils in this unit have rapid permeability and a low available water capacity. The organic-matter content is high in the surface layer. Surface runoff is very slow or ponded. These soils are subject to soil blowing during dry periods if they are not protected by a plant cover.

The major management concerns are wetness and maintaining fertility. A suitable drainage system is needed to remove excess water.

If they are adequately drained these soils are well suited to corn, soybeans, and small grain. They are also well suited to most special crops commonly grown in the county, such as tomatoes, onions, cabbage, and carrots.

CAPABILITY UNIT IIIw-4

This unit consists of deep, nearly level, somewhat poorly drained soils. These soils are on outwash plains. They are moderately coarse textured and coarse textured throughout.

Soils in this unit have moderately rapid and rapid permeability and a low available water capacity. The organic-matter content is moderate in the surface layer. Surface runoff is slow.

The major management concerns are wetness and improving the organic-matter content and fertility and maintaining good tilth.

A suitable, controlled drainage system is needed because the soils are droughty if overdrained. If tile is used, special filters are needed to prevent sand from seeping into the lines.

These soils are suited to crops commonly grown in the county. The main crops are corn, soybeans, and small grain.

CAPABILITY UNIT IIIw-8

This unit consists of deep, depressional to nearly level, very poorly drained, organic soils. These soils are on lake plains.

Soils in this unit have moderate permeability and a high available water capacity. The organic-matter content is very high. Surface runoff is very slow or ponded.

The major management concerns are wetness and preventing soil blowing.

Open ditches are used to control the water table. These ditches are supplemented by tile drains after the initial subsidence of the muck. Using crop residue and cover crops and minimum tillage help reduce soil blowing.

If they are adequately drained, these soils are well suited to corn, soybeans, and small grain. They are also well suited to all special crops grown in the county.

CAPABILITY UNIT IIIw-12

Quinn loam is the only soil in this unit. It is a deep, nearly level, poorly drained soil on outwash flats. It has a medium-textured surface layer and a medium-textured and moderately coarse textured subsoil.

This soil has moderate permeability and a moderate available water capacity. The organic-matter content is high in the surface layer. Surface runoff is slow.

The major management concerns are wetness and improving and maintaining the good organic-matter content, fertility, and tilth.

A suitable drainage system is needed to remove excess water. Using crop residue and green-manure crops helps improve and maintain the organic-matter content, fertility, and tilth.

If it is adequately drained, this soil is well suited to crops commonly grown in the county, mainly corn, soybeans, and small grain. This soil is also suited to

some special crops, including strawberries, tomatoes, and carrots.

CAPABILITY UNIT IIIs-1

This unit consists of deep, nearly level and gently sloping, well-drained and excessively drained soils. These soils are on outwash plains. They are coarse textured and moderately coarse textured throughout.

Soils in this unit have rapid or moderately rapid permeability and a low available water capacity. The organic-matter content is moderate in the surface layer. There is little or no hazard of erosion, and surface runoff is slow. Droughtiness is a problem during dry periods, and soil blowing is a hazard during dry periods if the soils have no plant cover.

The major management concerns are improving and maintaining the organic-matter content, fertility, and available water capacity.

Using crop residue and green-manure crops and minimum tillage help improve and maintain the organic-matter content, fertility, and available water capacity and prevent soil blowing.

The soils in this unit are poorly suited to corn, soybeans, and small grain. Some areas, however, are cultivated, but have limited production. The soils are suited to coniferous forest.

CAPABILITY UNIT IIIs-2

This unit consists of deep, nearly level, well-drained soils. These soils are on outwash terraces and plains. They have a moderately coarse textured surface layer and a coarse textured to moderately fine textured subsoil.

Soils in this unit have moderate or moderately rapid permeability and a moderate or low available water capacity. The organic-matter content is high in the surface layer. Surface runoff is slow. These soils tend to be droughty during dry periods.

The major management concerns are maintaining the organic-matter content and fertility and improving and maintaining the available water capacity.

Minimum tillage and using cover crops and green-manure crops help improve and maintain the organic-matter content, fertility, and available water capacity.

These soils are suited to crops commonly grown in the county. The main crops are corn, soybeans, small grain, and legume-grass mixtures.

CAPABILITY UNIT IVe-1

This unit consists of deep, well-drained, severely eroded soils that are moderately sloping and eroded soils that are strongly sloping. These soils are on uplands. They have a medium-textured surface layer and a moderately fine textured subsoil.

Soils in this unit have moderate permeability and a high available water capacity. The organic-matter content is moderate in the surface layer. Surface runoff is rapid.

The major management concerns are controlling surface runoff and erosion and improving and maintaining the organic-matter content, fertility, and good tilth.

Using crop residue, green-manure crops, and winter cover crops helps maintain the organic-matter content and fertility, improve tilth, and control erosion. Continuous vegetation limits erosion and surface runoff.

These soils are suited to small grain and grass-legume mixtures. Many acres are in deciduous forest.

CAPABILITY UNIT IVe-12

Tyner loamy sand, 6 to 12 percent slopes, is the only soil in this unit. It is a deep, strongly sloping, well-drained soil on outwash plains. It is coarse textured throughout.

This soil has rapid permeability and a low available water capacity. The organic-matter content is moderate in the surface layer. Surface runoff is medium. The soil is droughty during dry periods and is subject to soil blowing.

The major management concerns are improving the organic-matter content and fertility and controlling soil blowing.

If this soil is used for crops, minimum tillage and using crop residue, green-manure crops, and winter cover crops help maintain the organic-matter content and fertility and control soil blowing.

This soil is poorly suited to corn, soybeans, and small grain. It is suited to coniferous forest.

CAPABILITY UNIT IVe-13

Oshtemo sandy loam, 12 to 18 percent slopes, is the only soil in this unit. It is a deep, strongly sloping, well-drained soil on outwash plains. It has a moderately coarse textured surface layer and a coarse textured to moderately fine textured subsoil.

This soil has moderately rapid permeability and a low available water capacity. The organic-matter content is moderate in the surface layer. Surface runoff is medium.

The major management concerns are controlling surface runoff and erosion, improving the organic-matter content and fertility, and maintaining tilth. Minimum tillage and using crop residue, green-manure crops, and winter cover crops help improve and maintain the organic-matter content, fertility, and tilth, and control erosion.

This soil is suited to small grain and grass-legume mixtures. It is also suited to coniferous forest.

CAPABILITY UNIT IVe-15

Hillsdale complex, 12 to 18 percent slopes, eroded, is the only mapping unit in this capability unit. It consists of deep, strongly sloping, well-drained soils on till plains and moraines. These soils have a moderately coarse textured surface layer and a moderately coarse textured to moderately fine textured subsoil.

Soils in this unit have moderate permeability and a moderate available water capacity. The organic-matter content is moderate in the surface layer. Surface runoff is rapid.

The major management concerns are controlling surface runoff and erosion and improving and maintaining good tilth. Permanent vegetation controls surface runoff and erosion and helps maintain the organic-matter content and fertility.

These soils are suited to small grain and legume-grass mixtures.

CAPABILITY UNIT IVw-3

This unit consists of very poorly drained, depressional to nearly level, organic soils. These soils are deep over sand or moderately deep over marl.

Soils in this unit have moderate permeability in the organic layer, rapid permeability in the sand, and very slow permeability in the marl. They have a moderate to high available water capacity and a very high organic-matter content. Surface runoff is very slow or ponded.

The major management concerns are wetness and limiting soil blowing. Adequate drainage is needed to remove excess water. Cover crops, control of water levels, and windbreaks help control soil blowing.

These soils are suited to corn and soybeans if they are adequately drained. They are also used for small grain, legume-grass mixtures, and special crops, mainly potatoes, onions, cabbage, radishes, and mint.

CAPABILITY UNIT IVs-1

Brems fine sand, 0 to 2 percent slopes, is the only soil in this unit. It is a deep, nearly level, moderately well drained soil on outwash plains. It is coarse-textured throughout.

This soil has very rapid permeability and a low available water capacity. The organic-matter content is moderate in the surface layer. Surface runoff is slow. During dry periods the soil is droughty and is susceptible to soil blowing.

The major management concerns are improving and maintaining the organic-matter content and fertility and controlling soil blowing. Using crop residue and green-manure crops helps improve and maintain the organic-matter content, fertility, and tilth. Continuous vegetation limits soil blowing.

This soil is poorly suited to the crops commonly grown in the county. The main crops are corn, soybeans, small grain, and grass-legume mixtures.

CAPABILITY UNIT Vw-3

Alluvial land is the only mapping unit in this capability unit. It consists of deep, nearly level and depressional, very poorly drained soils.

These soils have high and very high organic-matter content. Surface runoff is very slow or ponded. Many areas have water at or near the surface most of the year.

Most areas generally are not farmed because of stream overflow and wetness. Areas that are farmed are adequately drained by open ditches or tile. Most areas are used as wildlife habitat.

CAPABILITY UNIT VIe-1

Miami clay loam, 12 to 18 percent slopes, severely eroded, is the only soil in this unit. It is a deep, strongly sloping, well-drained soil on glacial till plains. It has a moderately fine textured surface layer and subsoil.

This soil has moderate permeability and a high available water capacity. The organic-matter content is low in the surface layer. Runoff is rapid.

The major management concerns are controlling surface runoff and erosion and maintaining a thick plant cover.

Permanent grasses and legumes can be maintained by controlled grazing and by timely and adequate applications of lime and fertilizer. Renovating permanent pastures on the contour helps control erosion during the renovation period. Establishing and maintaining grassed waterways also help control erosion and runoff.

This soil is suited to pasture but is too steep and eroded for cultivated crops. It is also suited to woodland.

CAPABILITY UNIT VIe-6

Morley silty clay loam, 12 to 18 percent slopes, severely eroded, is the only soil in this unit. It is a deep, strongly sloping, well drained and moderately well drained soil on till plains and moraines. It has a moderately fine textured surface layer and a moderately fine textured and fine textured subsoil.

This soil has slow permeability and a high available water capacity. The organic-matter content is moderate in the surface layer. Surface runoff is rapid.

The major management concern is controlling surface runoff and erosion. Permanent pasture can be maintained by controlled grazing and by timely and adequate applications of lime and fertilizer. Pasture should be renovated on the contour to help control erosion. Establishing and maintaining grassed waterways also help control erosion and runoff.

This soil is suited to pasture, but grass is difficult to establish because of the severe erosion. It is also suited to woodland.

CAPABILITY UNIT VIe-12

Tyner loamy sand, 12 to 18 percent slopes, is the only soil in this unit. It is a deep, well-drained, strongly sloping soil on outwash plains and terraces. It is coarse textured throughout.

This soil has rapid permeability and a low available water capacity. The organic-matter content is moderate. Surface runoff is medium.

The major management concern is controlling surface runoff and erosion.

Permanent pasture can be maintained by controlling grazing and by timely and adequate applications of lime and fertilizer. Pasture should be renovated in small strips on the contour to help control erosion.

This soil is suited to permanent pasture and woodland.

Predicted yields

Table 2 shows, for each soil in St. Joseph County, the average yields per acre of the principal crops under a high level of management.

The yields shown in table 2 are estimated averages for a period of 5 to 10 years. They are based on farm records, on interviews with farmers, members of the Purdue Agricultural Experiment Station, and area extension agents, and on direct observations by soil scientists and soil conservationists. Considered in the estimates were the prevailing climate, the characteristics of the soils, and the influence of a high level of management on the soils.

These yield figures do not apply to specific tracts of land for any particular year, because the soils differ somewhat from place to place, management practices differ from farm to farm, and weather conditions vary from year to year. Nevertheless, these estimates show the relative productivity of the soils under a high level of management.

The following practices are assumed to be part of a high-level management system:

1. Using cropping systems that maintain the tilth and organic-matter content.
2. Controlling erosion as much as possible so that the quality of the soil is maintained or improved rather than reduced.
3. Maintaining a high level of fertility by using fertilizer according to the results of frequent soil tests and recommendations of Purdue University Agricultural Experiment Station.

TABLE 2.—*Predicted average yields per acre of principal crops under a high level of management*

[Dashes indicate that the crop is either not grown or is not suited to the soil. Alluvial land, Gravel pits, Made land, and Marsh are not listed because they are not suited to these crops]

Soil	Corn	Soybeans	Wheat	Legume-grass hay	Fescue pasture
	Bu	*Bu*	*Bu*	*Tons*	*AUM* [1]
Adrian muck, drained	120	42	48	4.0	-------
Alida loam, 0 to 2 percent slopes	115	40	46	3.8	7.6
Aubbeenaubbee sandy loam	110	38	50	3.6	7.6
Blount silt loam, 0 to 2 percent slopes	105	37	47	3.4	6.8
Brady sandy loam	95	33	43	3.1	6.2
Brems fine sand, 0 to 2 percent slopes	70	24	32	2.3	4.8
Brookston silty clay loam	145	51	65	4.8	9.5
Chelsea fine sand, 0 to 5 percent slopes	65	23	29	2.1	4.6
Chelsea fine sand, 5 to 10 percent slopes	55	19	25	1.8	3.6
Coupee silt loam, 0 to 2 percent slopes	95	33	48	3.1	6.6
Crosier loam, 0 to 2 percent slopes	105	37	47	3.4	6.5
Crosier loam, 2 to 4 percent slopes	105	37	47	3.4	6.5
Del Rey silt loam	105	37	47	3.4	6.5
Edwards muck	110	38	44	3.6	7.2
Elston sandy loam, 0 to 2 percent slopes	90	32	40	3.0	6.6
Fox sandy loam, 0 to 2 percent slopes	85	30	42	2.8	5.5
Fox sandy loam, 2 to 6 percent slopes	85	30	42	2.8	5.5
Gilford sandy loam	120	42	54	4.0	8.0
Hillsdale sandy loam, 0 to 2 percent slopes	90	32	40	3.0	6.0
Hillsdale sandy loam, 2 to 6 percent slopes	90	32	40	3.0	6.0
Hillsdale complex, 6 to 12 percent slopes, eroded	80	28	36	2.6	5.5
Hillsdale complex, 12 to 18 percent slopes, eroded	65	23	29	2.1	4.2
Houghton muck	-------	-------	-------	-------	-------
Houghton muck, drained	130	46	52	4.3	8.6
Landes loam	120	42	48	4.0	8.5
Martinsville loam, 0 to 2 percent slopes	120	42	48	4.0	8.0
Martinsville loam, 2 to 6 percent slopes, eroded	120	42	48	4.0	8.0
Martinsville loam, 6 to 12 percent slopes, eroded	105	37	42	3.4	6.8
Maumee loamy fine sand	110	38	50	3.6	7.2
Maumee mucky loamy fine sand	120	42	48	4.0	8.0
Metea loamy fine sand, 4 to 10 percent slopes	85	30	42	2.8	5.5

TABLE 2.—*Predicted average yields per acre of principal crops under a high level of management*—Continued

Soil	Corn	Soybeans	Wheat	Legume-grass hay	Fescue pasture
Miami loam, 2 to 6 percent slopes	110	38	50	3.6	7.2
Miami loam, 6 to 12 percent slopes, eroded	95	33	43	3.1	6.5
Miami clay loam, 6 to 12 percent slopes, severely eroded	90	32	40	3.0	6.0
Miami clay loam, 12 to 18 percent slopes, severely eroded	75	26	32	2.5	5.0
Milford silty clay loam	135	47	61	4.4	8.8
Morley silt loam, 2 to 6 percent slopes, eroded	95	33	43	3.1	6.2
Morley silt loam, 6 to 12 percent slopes, eroded	80	28	36	2.6	5.2
Morley silty clay loam, 12 to 18 percent slopes, severely eroded	55	19	25	1.8	3.6
Oshtemo sandy loam, 0 to 2 percent slopes	85	30	38	2.8	5.6
Oshtemo sandy loam, 2 to 6 percent slopes	85	30	38	2.8	5.6
Oshtemo sandy loam, 6 to 12 percent slopes, eroded	75	26	34	2.5	5.0
Oshtemo sandy loam, 12 to 18 percent slopes	60	21	27	2.0	4.0
Palms muck, drained	135	47	54	4.4	----
Quinn loam	125	44	50	4.1	8.3
Rensselaer loam	150	53	60	5.0	10.5
Rensselaer mucky loam	150	53	60	5.0	10.5
Riddles loam, 0 to 2 percent slopes	120	42	48	4.0	8.0
Riddles loam, 2 to 6 percent slopes	120	42	48	4.0	8.0
Riddles loam, 6 to 12 percent slopes, eroded	105	37	42	3.4	6.8
Riddles loam, 12 to 18 percent slopes, eroded	90	32	36	3.0	6.0
Tedrow fine sand	80	28	36	2.6	5.2
Tracy sandy loam, 0 to 2 percent slopes	85	30	42	2.8	5.6
Tracy sandy loam, 2 to 6 percent slopes	85	30	42	2.8	5.6
Tracy sandy loam, 6 to 12 percent slopes, eroded	70	24	35	2.3	5.6
Troxel silt loam	135	47	54	4.4	4.6
Tyner loamy sand, 0 to 6 percent slopes	70	24	32	2.3	8.8
Tyner loamy sand, 6 to 12 percent slopes	60	21	27	2.0	4.6
Tyner loamy sand, 12 to 18 percent slopes	45	16	20	1.5	4.0
Wallkill silt loam	140	49	56	4.6	3.0
Washtenaw silt loam	130	46	52	4.3	8.5
Whitaker loam	130	46	52	4.3	8.5

[1] AUM is animal-unit-months, a term used to express the carrying capacity of pasture. It is the number of months during the grazing season that 1 acre will provide grazing for 1 animal unit (1 cow, horse, or mule, 5 hogs, or 7 sheep) without damage to the pasture. For example, an acre of pasture that provides 2 months of grazing for 5 cows has a carrying capacity of 10 animal-unit-months.

4. Liming the soils according to the results of soil tests.
5. Using crop residue as much as possible to protect and improve the soil.
6. Keeping tillage to the minimum where needed to reduce compaction and erosion.
7. Using only the crop varieties that are best suited to the climate and the soil.
8. Controlling weeds carefully by tillage and spraying.
9. Draining wet areas adequately.

Special crops

Special crops are grown on about 2 percent of the cropland in St. Joseph County and account for about 10 percent of the gross farm income. The main special

crops are sweet corn, potatoes, onions, radishes, carrots, asparagus, cabbage, lettuce, peppers, snap-beans, pumpkins, squash, melons, cucumbers, strawberries, tomatoes, mint, and blueberries.

To facilitate management, the soils in this county have been placed in special crop groups. The soils in each group are similar in their suitability for special crops and in the management they need.

The eight special crop groups are described in the following pages. The special group for each soil in the county is listed in the "Guide to Mapping Units" at the back of the survey.

SPECIAL CROP GROUP 1

This group consists of organic soils that generally have 16 to 51 inches or more of muck over mineral soil material. These soils are underlain by marl or by material of coarse, moderately coarse, medium, or moderately fine texture. In some places less than 12 inches of muck overlies marl.

These soils have good tilth and very high organic-matter content. The available water capacity is high. Runoff is very slow or ponded, and permeability is rapid in the organic layer and moderate or variable in the underlying material. The soils have a high water table. Most of these soils are drained. Soil blowing is a hazard where the surface layer is dry if it is not protected by a plant cover.

Under good management that provides suitable drainage, the soils in this group are well suited to most special crops. Where these soils are very strongly acid, they are well suited to blueberries. They are not suited to pumpkins, squash, melons, cucumbers, strawberries, and other low-growing vine crops.

SPECIAL CROP GROUP 2

This group consists of deep, somewhat poorly drained to very poorly drained soils. These soils are dominantly nearly level to depressional, and they are mainly on outwash plains and lake plains. The surface layer is coarse textured or medium textured, and the subsoil is coarse textured to moderately fine textured. In most places the underlying material is coarse textured in the outwash soils and moderately fine textured and fine textured in the lacustrine soils. In other places the underlying material is muck or medium-textured till.

These soils have good tilth and moderate or high organic-matter content and natural fertility. The available water capacity ranges from low to high, and runoff is slow, very slow, or ponded. Water moves readily through most of these soils. The water table is at or near the surface in spring or during long periods of heavy rainfall. If the soils are drained, they warm up early in spring and can be tilled and planted earlier than when they are wet. Soil blowing is a hazard if the soils are not protected by a plant cover or windbreaks.

Under good management that provides adequate drainage, most soils in this group are well suited to all special crops commonly grown in the county. The soils that have a mucky surface, however, are not suited to pumpkins, squash, melons, cucumbers, strawberries, and other low-growing vine crops.

SPECIAL CROP GROUP 3

This group consists of deep, poorly drained and very poorly drained, nearly level or depressional soils on uplands. These soils have a moderately fine textured or fine textured surface layer and subsoil.

These soils have poor tilth, high organic-matter content in the surface layer, and high natural fertility. Permeability is moderate or moderately slow, and surface runoff is very slow or ponded. Internal drainage is very slow, and the available water capacity is high. These soils are wet until late in spring. If they are cultivated when wet, the water puddles and hard clods form.

Soils in this group generally are poorly suited to special crops because their permeability and drainage make tillage difficult.

SPECIAL CROP GROUP 4

This group consists of deep, somewhat poorly drained, nearly level soils on uplands. The surface layer is medium textured, and the subsoil and underlying material are moderately fine textured.

These soils have a high available water capacity and slow permeability. Surface runoff is slow. An adequate drainage system is needed because the water table is near the surface in spring. The wetness delays tillage. To maintain good tilth, the soils should not be worked when they are wet.

Under good management that provides adequate drainage, the soils in this group are moderately well suited to all special crops.

SPECIAL CROP GROUP 5

This group consists of deep, moderately well drained and well drained soils. These soils are nearly level to moderately sloping, and they are on uplands and flood plains. The surface layer is medium textured, and the subsoil and underlying material are medium textured and moderately fine textured.

These soils have a moderate or high available water capacity and slow to moderate permeability. The surface layer has good tilth but, because of the texture of the subsoil, it remains wet for short periods after rains. Because slopes are dominantly nearly level and gently sloping, the hazard of erosion is moderate.

Under good management these soils are well suited to all special crops. The slow and moderate permeability delays tillage during wet periods.

SPECIAL CROP GROUP 6

This group consists of deep, well drained or moderately well drained, nearly level and gently sloping soils on outwash plains. These soils have a coarse-textured to medium-textured surface layer and a coarse-textured to moderately fine textured subsoil or underlying material.

These soils have a moderate and low available water capacity. They are easy to cultivate and can be worked shortly after a rain because water soaks into the surface layer adequately. These soils are medium acid to neutral. Runoff is slow and medium. The hazard of erosion is slight or moderate.

Under improved management soils are well suited to most special crops grown in the county. Irrigation is

needed for maximum production of potatoes and snapbeans.

SPECIAL CROP GROUP 7

This group consists of deep, moderately well drained to excessively drained soils. These soils are nearly level and gently sloping, and they are on outwash plains. The surface layer, subsoil, and underlying material are coarse textured.

These soils have a low available water capacity and rapid or very rapid permeability. They are droughty and are subject to severe soil blowing if a plant cover is not maintained.

The soils in this group are not suited to special crops unless they are irrigated.

SPECIAL CROP GROUP 8

This group consists of moderately well drained to excessively drained soils. These soils mainly are moderately sloping and strongly sloping. The surface layer is coarse textured to medium textured.

These soils have low or moderate organic-matter content and fertility and poor tilth. Droughtiness is a severe limitation on the sandy soils. Surface runoff is medium to very rapid, and the soils are eroded or severely eroded. Gullies are likely to form if erosion is not adequately controlled.

If these soils are cultivated, management practices should include contour farming, stripcropping, establishing waterways and diversions, and terracing to help control runoff and reduce erosion.

The soils in this group are poorly suited to special crops because of the severe hazard of erosion and droughtiness.

Use of the Soils for Woodland [2]

The soils of St. Joseph County have been placed in woodland suitability groups to assist owners in planning the use of their soils for wood crops. Each group is made up of soils that are suited to the same kind of trees, that need the same kind of management when the vegetation on them is similar, and that have about the same potential productivity.

Each woodland group is generally identified by a three-part symbol, such as 1o1, 3w5, or 4w21. The first part of the symbol, always a number (except, in this county, for Group o23), indicates the relative potential productivity of the soils in the group. The number 1 means very high potential productivity, 2 means high, 3 means moderately high, 4 means moderate, and 5 means low. These ratings are based on field determinations of average site index. Site index is the height, in feet, that the dominant trees of a given species reach in a natural, unmanaged stand in a certain number of years. For the merchantable hardwoods and softwoods in this county, the site index is the height reached in 50 years.

Site indexes are grouped into site quality classes. The classes are used to determine approximate yields per acre in cords and board feet by the methods shown in published material (*4, 5*).

The second part of the symbol identifying a woodland group is a lowercase letter. This letter indicates an important soil property that imposes a hazard or limitation for managing the soils for wood crops. The letter *o* shows that the soils have few limitations; *c* shows that the main limitation is the kind or amount of clay in the upper part of the soil; *r* shows that the main limitation is steep slopes; *s* shows that the soils are sandy and dry, have little or no difference in texture between the surface layer and subsoil, have a low available water capacity, and generally have a low supply of plant nutrients; and *w* shows that water in or on the soil, either seasonally or year round, is the chief limitation.

The third part of the symbol identifies the group within the statewide system. Identification numbers are generally assigned locally. The numbers in this soil survey are not consecutive because all the groups in the system are not represented in St. Joseph County.

In table 3, each woodland group is briefly described, and site indexes are given for the important trees for each group. The groups are rated according to hazards and limitations that affect management. The most desirable trees to favor in natural stands and trees suitable for planting are also listed.

The hazards or limitations that affect management of soils for woodland are windthrow hazard, erosion hazard, equipment limitations, seedling mortality, and plant competition. In table 3 they are rated *slight, moderate,* or *severe.*

Erosion hazard refers to the potential hazard of soil loss in woodland. The hazard is *slight* if the expected soil loss is small; *moderate* if some soil loss is expected and care is needed during logging and construction to control erosion; and *severe* if special methods of operation are necessary to prevent excessive soil loss. In St. Joseph County, only the steep soils are subject to severe erosion.

Equipment limitations are rated on the basis of soil characteristics that restrict or prohibit the use of equipment commonly used in tending and harvesting the trees. In St. Joseph County, the soil characteristics that cause the most limitations are drainage, depth to the water table, slope, and texture of the surface layer. *Slight* means there is no restriction in the kind of equipment or in the time of year it is used. *Moderate* means that the use of equipment is restricted for less than 3 months of the year. *Severe* means that special equipment is needed and its use is restricted for more than 3 months of the year.

Seedling mortality refers to the expected degree of mortality of planted seedlings as influenced by the kind of soil. Plant competition is not a limiting factor. Considered in the ratings are depth to the water table, hazard of flooding, drainage, soil depth and structure, and degree of erosion. Normal rainfall, good planting stock, and proper planting are assumed. A rating of

[2] MITCHELL G. HASSLER, woodland conservationist, Soil Conservation Service, helped prepare this section.

slight indicates an expected loss of less than 25 percent of the planted seedlings; *moderate,* a loss of 25 to 50 percent of the seedlings; and *severe,* a loss of more than 50 percent of the seedlings. Special preparation of the site is needed before planting for soils rated severe and for most soils rated moderate.

Windthrow hazard refers to the effect of the soil on root development and the ability of the soil to hold trees firmly. *Slight* means that roots can extend to a depth of more than 20 inches, and the trees withstand most wind. *Moderate* means that roots can extend to a depth of 10 to 20 inches, and some trees are blown down by strong wind when the soil is excessively wet. *Severe* means that roots can extend only to a depth of less than 10 inches, and the trees will not stand alone in strong wind.

Plant competition is the degree to which unwanted plants invade openings in the tree canopy. Considered in the ratings are available water capacity, fertility, drainage, and degree of erosion. *Slight* means that competition from other plants is not a problem. *Moderate* means that plant competition delays the development of fully stocked stands of desirable trees. *Severe* means that plant competition prevents the establishment of a desirable stand unless intensive site preparation and such practices as weeding are used to control undesirable plants.

Use of the Soils for Wildlife Habitat

Soil suitability is an important factor in planning, developing, and managing areas for wildlife. Proper manipulation of soil, water, and plants to produce suitable habitat is the most effective way to maintain and improve wildlife populations.

This section deals with relationships between the kinds of soil and the kinds of plant and water developments that make up wildlife habitat. Other important factors, such as present land use, size and shape of soil areas, the patterns soils form with other soils on the landscape, and existing wildlife and their ability to move from place to place, require onsite investigation.

Each soil is rated in table 4 for its suitability for the improvement, maintenance, or creation of specific elements of wildlife habitat for three kinds of wildlife. The ratings indicate the best sites for habitat management and the intensity of management needed to produce satisfactory results. They are a means of grouping soils for broad-scale planning for wildlife.

Good means that habitats are easily improved, maintained, or created, that there are few or no soil limitations in habitat management, and that satisfactory results can be expected. *Fair* means that habitats can be improved, maintained, or created, but moderate soil limitations affect habitat management or development. A moderate intensity of management and fairly frequent attention may be required for satisfactory results. *Poor* means that habitats can be improved, maintained, or created, but the soil limitations are severe. Habitat management may be difficult and expensive and require intensive effort. Results may not be satisfactory. *Very poor* means that the soil limitations are so severe that it is not practical to improve, maintain, or create habitats. Unsatisfactory results are probable.

Soil characteristics considered in the ratings for elements of wildlife habitat are the thickness of soil material useful to crops, texture of the surface layer, available water capacity, drainage, and hazard of flooding. The elements of wildlife habitat in table 4 are defined in the following paragraphs.

Grain and seed crops are domestic grains or seed crop-producing annual herbaceous plants that produce food for wildlife. Examples are corn, sorghum, wheat, oats, soybeans, millet, buckwheat, and sunflowers.

Domestic grasses and legumes are domestic perennial grasses and herbaceous legumes that furnish cover and food for wildlife. Examples are fescue, brome, timothy, redtop, orchardgrass, reed canarygrass, clover, trefoil, alfalfa, sericea lespedeza, and crownvetch.

Coniferous plants are used by wildlife mainly as cover, but they also furnish food in the form of browse, seeds, or fruitlike cones. Examples are pine, spruce, white cedar, hemlock, redcedar, juniper, and yew.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites, not including submerged or floating aquatics. They produce food and cover for wetland wildlife. Examples are smartweed, wild millet, bulrushes, sedges, reeds, cattails, and pondweeds.

Shallow water developments are impoundments or excavations generally not more than 5 feet deep. Examples are low dikes and levees, shallow dugouts, level ditches, devices for water level control, or marshy streams and channels.

The ratings for kinds of wildlife are based on the ratings for the elements of wildlife habitat. For example, grain and seed crops, domestic grasses and legumes, and wild herbaceous plants are more important than hardwood trees as habitat elements for openland wildlife. The three kinds of wildlife in table 4 are defined in the following paragraphs.

Openland wildlife includes birds and mammals that live in fields, pastures, meadows, lawns, and areas overgrown with grasses, herbs, vines, and shrubs. Examples are quail, pheasant, cottontail rabbit, meadowlark, field sparrow, killdeer, red fox, and woodchuck.

Woodland wildlife includes birds and mammals that live in areas of hardwood and coniferous trees and shrubs. Examples are woodcocks, thrushes, vireos, woodpeckers, gray and fox squirrel, gray fox, raccoon, and white-tailed deer.

Wetland wildlife includes birds and mammals that live in streams, ponds, ditches, marshes, and swamps. Examples are ducks, geese, herons, shore birds, rails, kingfishers, mink, and muskrat.

Engineering Uses of the Soils [3]

This section is useful to those who need information about soils used as structural material or as foundation

[3] RONALD G. SHEFFLER, agricultural engineer, Soil Conservation Service, helped prepare this section.

TABLE 3.—*Suitability of*

[Alluvial land (Am), Gravel pits (GP), Made land (Ma), and Marsh (Mc) are not assigned a woodland suitability

Woodland suitability group	Potential productivity		Hazards and limitations affecting management	
	Trees	Site index	Erosion hazard	Equipment limitations
Group 1o1. Deep, well drained and moderately well drained, nearly level to strongly sloping soils that have a high available water capacity. MeA, MeB2, MeC2, MmB, MmC2, MoC3, MoD3, MrB2, MrC2, MsD3, RtA, RtB, RtC2, RtD2.	Upland oaks Tulip-poplar Sweetgum	85–95 95–105 70–80	Slight to moderate	Slight to moderate
Group 1r2. Deep and moderately deep, well-drained, nearly level to strongly sloping soils that have a moderate or low available water capacity. FsA, FsB, HdA, HdB, HeC2, HeD2.	Upland oaks Tulip-poplar	85–95 95–105	Slight to moderate	Slight to moderate
Group 1o8. Deep, moderately well drained, nearly level soil that has a moderate available water capacity. La.	Tulip-poplar	95–105	Slight	Slight
Group 3w5. Deep, somewhat poorly drained, nearly level and gently sloping soils that have a moderate, high, or low available water capacity. AeA, Au, BbA, CtA, CtB, De, Wt.	Upland oaks Tulip-poplar Pin oak Sweetgum	70–80 80–90 80–90 75–85	Slight	Moderate
Group 2w11. Deep, very poorly drained and poorly drained, depressional and nearly level soils that have a high available water capacity. Br, Mp, Qu, Re, Rm, Ws.	Pin oak Upland oaks Sweetgum	80–90 70–80 85–95	Slight	Severe
Group 2s15. Deep, well-drained, sloping soil that has a moderate available water capacity. MkB.	Upland oaks Tulip-poplar Red pine White pine	75–85 75–85 70–80 80–90	Slight to moderate	Moderate
Group 3s17. Deep, moderately well drained, well drained, and excessively drained, nearly level to strongly sloping soils that have a low or moderate available water capacity. BeA, ChA, ChC, OsA, OsB, OsC2, OsD, TrA, TrB, TrC2, TyA, TyC, TyD.	Upland oaks Red pine White pine Jack pine	65–75 75–80 80–90 65–75	Moderate	Moderate
Group 3w20. Deep, somewhat poorly drained, nearly level soils that have a low available water capacity. Bd, Te.	Upland oaks White pine Pin oak Sweetgum	70–80 80–90 80–90 75–85	Slight	Moderate
Group 4w21. Deep, poorly drained and very poorly drained, depressional and nearly level soils that have a moderate or low available water capacity. Gf, Mf, Mg.	Pin oak White pine Aspen	65–75 70–80 65–75	Slight	Severe
Group o23. Deep, well-drained, nearly level and depressional soils that have a high organic-matter content and a moderate available water capacity. CoA, EsA, Tx.	Upland oaks Red pine White pine	65–75 75–80 80–90	Slight	Slight
Group 4w23. Deep, very poorly drained, depressional to nearly level, organic soils that have a high available water capacity. Ad, Ed, Hm, Ho, Pa, Wk.	No data available	No data available.	Slight	Severe

the soils for woodland

group and are not listed in this table because their properties are too variable for reliable interpretations to be made]

Hazards and limitations affecting management—Continued			Suitable trees—	
Seedling mortality	Windthrow hazard	Plant competition	To favor in existing stands	For planting
Slight to moderate	Slight	Moderate	Sugar maple, tulip-poplar, white ash, red oak, white oak, black locust.	White pine, black locust, red pine, tulip-poplar.
Slight to moderate	Slight	Moderate	White oak, tulip-poplar, red oak, white ash, black walnut, sugar maple.	White pine, red pine, black walnut, tulip-poplar.
Slight	Slight	Moderate	Black walnut, white ash, cottonwood, sycamore, tulip-poplar.	White pine, tulip-poplar, black walnut, black locust.
Slight	Moderate to severe	Moderate	Sweetgum, pin oak, soft maple, white ash, tulip-poplar, bur oak.	White ash, white pine, sweetgum, soft maple, sycamore, tulip-poplar.
Severe	Severe	Severe	Bur oak, pin oak, red maple, sweetgum, white ash.	Red maple, sweetgum, white ash.
Slight	Slight	Slight	White oak, tulip-poplar, black oak, red oak, black walnut.	White pine, red pine, tulip-poplar, black walnut.
Moderate	Slight	Slight	Black oak, white oak, red oak, white ash, black cherry.	White pine, red pine, jack pine.
Slight	Moderate to severe	Slight	Pin oak, black oak, sweetgum, soft maple.	White pine, sweetgum, soft maple.
Slight	Severe	Slight	Pin oak, red maple, black oak.	White pine, European larch, black spruce.
Slight	Slight	Slight	Black oak, white oak, red oak.	White pine, red pine, jack pine.
Slight	Severe	Slight	No existing stands	Purple willow, white pine, American arborvitae.

TABLE 4.—*Suitability of the soils for elements*

[Gravel pits (GP) and Made land (Ma) are not listed in the table because

Soil series and map symbols	Elements of wildlife habitat			
	Grain and seed crops	Domestic grasses and legumes	Wild herbaceous plants	Hardwood trees
Adrian: Ad	Poor	Poor	Poor	Poor
Alida: AeA	Fair	Good	Good	Good
Alluvial land: Am	Very poor	Poor	Poor	Poor
Aubbeenaubbee: Au	Fair	Good	Good	Good
Blount: BbA	Fair	Good	Good	Good
Brady: Bd	Fair	Good	Good	Good
Brems: BeA	Poor	Poor	Good	Poor
Brookston: Br	Fair	Poor	Poor	Poor
Chelsea: ChA, ChC	Poor	Poor	Fair	Poor
Coupee: CoA	Good	Good	Good	Good
Crosier:				
CtA	Fair	Good	Good	Good
CtB	Fair	Good	Good	Good
Del Rey: De	Fair	Good	Good	Good
Edwards: Ed	Very poor	Poor	Poor	Poor
Elston: EsA	Good	Good	Good	Good
Fox:				
FsA	Good	Good	Good	Good
FsB	Fair	Good	Good	Good
Gilford: Gf	Fair	Poor	Poor	Fair
Hillsdale:				
HdA	Good	Good	Good	Good
HdB	Good	Good	Good	Good
HeC2	Fair	Good	Good	Good
HeD2	Poor	Fair	Good	Good
Houghton:				
Hm	Very poor	Very poor	Very poor	Very poor
Ho	Poor	Poor	Poor	Poor
Landes: La	Poor	Fair	Fair	Good
Marsh: Mc	Very poor	Very poor	Very poor	Very poor
Martinsville:				
MeA, MeB2	Good	Good	Good	Good
MeC2	Fair	Good	Good	Good
Maumee:				
Mf	Fair	Poor	Poor	Fair
Mg	Poor	Poor	Poor	Fair
Metea: MkB	Fair	Good	Good	Good
Miami:				
MmB, MmC2	Fair	Good	Good	Good
MoC3	Fair	Good	Good	Good
MoD3	Poor	Fair	Good	Good
Milford: Mp	Fair	Poor	Poor	Poor
Morley:				
MrB2	Fair	Good	Good	Good
MrC2	Fair	Good	Good	Good
MsD3	Poor	Fair	Good	Good
Oshtemo:				
OsA, OsB, OsC2	Fair	Fair	Fair	Fair
OsD	Poor	Fair	Fair	Fair

of wildlife habitat and kinds of wildlife

their properties are too variable for reliable interpretations to be made]

Elements of wildlife habitat—Continued			Kinds of wildlife		
Coniferous plants	Wetland plants	Shallow water developments	Openland	Woodland	Wetland
Poor	Good	Good	Poor	Poor	Good.
Good	Good	Fair	Good	Good	Fair.
Poor	Good	Good	Poor	Poor	Good.
Good	Fair	Fair	Good	Good	Fair.
Good	Good	Good	Good	Good	Good.
Good	Fair	Fair	Good	Good	Fair.
Poor	Poor	Poor	Fair	Poor	Poor.
Poor	Good	Good	Poor	Poor	Good.
Poor	Very poor	Very poor	Poor	Poor	Very poor.
Good	Poor	Poor	Good	Good	Poor.
Good	Good	Good	Good	Good	Good.
Good	Poor	Poor	Good	Good	Poor.
Good	Good	Good	Good	Good	Good.
Poor	Good	Good	Poor	Poor	Good.
Good	Poor	Poor	Good	Good	Poor.
Good	Poor	Poor	Good	Good	Poor.
Good	Poor	Poor	Good	Good	Poor.
Poor	Good	Good	Poor	Poor	Good.
Good	Poor	Poor	Good	Good	Poor.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Very poor	Good	Good	Very poor	Very poor	Good.
Poor	Good	Good	Poor	Poor	Good.
Poor	Poor	Poor	Fair	Good	Poor.
Very poor	Good	Good	Very poor	Very poor	Good.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Poor	Very poor	Good	Good	Very poor.
Poor	Good	Good	Poor	Poor	Good.
Poor	Good	Good	Poor	Poor	Good.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Fair	Fair	Very poor.
Poor	Good	Good	Poor	Poor	Good.
Good	Poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Fair	Fair	Very poor.
Fair	Very poor	Very poor	Fair	Fair	Very poor.
Fair	Very poor	Very poor	Fair	Fair	Very poor.

TABLE 4.—*Suitability of the soils for elements*

Soil series and map symbols	Elements of wildlife habitat			
	Grain and seed crops	Domestic grasses and legumes	Wild herbaceous plants	Hardwood trees
Palms: Pa	Very poor	Poor	Poor	Poor
Quinn: Qu	Fair	Fair	Fair	Fair
Rensselaer:				
Re	Fair	Poor	Poor	Poor
Rm	Poor	Poor	Poor	Poor
Riddles:				
RtA	Good	Good	Good	Good
RtB	Good	Good	Good	Good
RtC2	Fair	Good	Good	Good
RtD2	Poor	Fair	Good	Good
Tedrow: Te	Fair	Fair	Good	Poor
Tracy:				
TrA	Good	Good	Good	Good
TrB	Good	Good	Good	Good
TrC2	Fair	Good	Good	Good
Troxel: Tx	Good	Good	Good	Good
Tyner: TyA, TyC, TyD	Poor	Fair	Fair	Fair
Wallkill: Wk	Fair	Poor	Poor	Poor
Washtenaw: Ws	Fair	Poor	Poor	Poor
Whitaker: Wt	Fair	Good	Good	Good

upon which structures are built. Among those who can benefit from this section are planning commissions, town and city managers, land developers, engineers, contractors, and farmers.

Among properties of soils highly important in engineering are permeability, strength, compaction characteristics, drainage, shrink-swell potential, grain size, plasticity, and reaction. Also important are depth to the water table, depth to bedrock, and slope. These properties, in various degrees and combinations, affect construction and maintenance of roads, airports, pipelines, foundations, irrigation systems, ponds, and small dams, and systems for disposal of sewage and refuse.

Information in this section of the soil survey can be helpful to those who—

1. Select potential residential, industrial, commercial, and recreation areas.
2. Evaluate alternate routes for roads, highways, pipelines, and underground cables.
3. Seek sources of gravel, sand, or clay.
4. Plan drainage systems, irrigation systems, ponds, terraces, and other structures for controlling water and conserving soil.
5. Correlate performance of structures already built with properties of the kinds of soil on which they are built, for the purpose of predicting performance of structures on the same or similar kinds of soil in other locations.
6. Predict the trafficability of soils for cross-country movement of vehicles and construction equipment.
7. Develop preliminary estimates pertinent to construction in a particular area.

Most of the information in this section is presented in table 5, which gives the results of engineering laboratory tests on soil samples; table 6, which lists estimated soil properties significant in engineering; and table 7, which gives interpretations of soil properties for various engineering uses.

This information, along with the soil map and other parts of this publication, can be used to make interpretations in addition to those given in the tables, and it can be used to make other useful maps.

This information, however, does not eliminate the need for further investigations at sites selected for engineering works, especially works that involve heavy loads or that require excavations to depths greater than

of wildlife habitat and kinds of wildlife—Continued

Elements of wildlife habitat—Continued			Kinds of wildlife		
Coniferous plants	Wetland plants	Shallow water developments	Openland	Woodland	Wetland
Poor	Good	Good	Poor	Poor	Good.
Fair	Good	Good	Fair	Fair	Good.
Poor	Good	Good	Poor	Poor	Good.
Poor	Good	Good	Poor	Poor	Good.
Good	Poor	Poor	Good	Good	Poor.
Good	Poor	Very poor	Good	Good	Poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Good	Very poor	Very poor	Fair	Fair	Very poor.
Poor	Poor	Poor	Fair	Fair	Poor.
Good	Poor	Poor	Good	Good	Poor.
Good	Poor	Very poor	Good	Good	Poor.
Good	Very poor	Very poor	Good	Good	Very poor.
Good	Poor	Poor	Good	Good	Poor.
Fair	Very poor	Very poor	Fair	Fair	Very poor.
Poor	Good	Good	Poor	Poor	Good.
Poor	Good	Good	Poor	Poor	Good.
Good	Good	Fair	Good	Good	Fair.

those shown in the tables, generally depths of more than 6 feet. Also, inspection of sites, especially the small ones, is needed because many mapped areas of a given soil may contain small areas of other kinds of soil that have strongly contrasting properties and different suitabilities or limitations for engineering.

Some of the terms used in this soil survey have special meaning to soil scientists. The "Glossary" defines many of the terms commonly used in soil science.

Engineering soil classification systems

The two systems most commonly used in classifying soils for engineering are the Unified system (*2*) used by SCS engineers, the Department of Defense, and others, and the AASHTO system (*1*), adopted by the American Association of State Highway and Transportation Officials.

The Unified system is used to classify soil for building material or for the support of structures other than highways. Soils are classified according to particle-size distribution, plasticity index, liquid limit, and organic-matter content. Soils are grouped into 15 classes. There are eight classes of coarse-grained soils divided on the basis of gravel and sand content. These are identified as GW, GP, GM, GC, SW, SP, SM, and SC. Six classes of fine-grained soils are divided on the basis of the plasticity index. Nonplastic classes are ML, MH, OL, and OH; plastic classes are CL and CH. There is one class of highly organic soils, Pt. Soils on the borderline between two classes are designated by symbols for both classes; for example, CL-ML.

The AASHTO system is used to classify soils for use in highway construction and maintenance. In this system, a soil is placed in one of seven basic groups ranging from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. In group A-1 are gravelly soils of high bearing strength, or the best soils for subgrade (foundation). At the other extreme, in group A-7, are clay soils that have low strength when wet and that are the poorest soils for subgrade. Where laboratory data are available to justify a further breakdown, the A-1, A-2, and A-7 groups are divided as follows: A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, and A-7-6. As an additional refinement, the engineering value of a soil material can be indicated by a group index number. Group indexes range from 0 for the best material to 20 or more for the poorest. The AASHTO classification for tested soils, with group index numbers in parentheses, is shown in table 5; the estimated classification, with-

TABLE 5.—*Engineering*

[These tests were performed in the laboratories of Purdue University under joint sponsorship of the Indiana State Highway Transportation Officials (AASHTO) (*1*). The test data in this table may not agree with the estimated soil properties shown in tion in the soils laboratory]

Soil name and location	Parent material	SCS Report No. BPR-S -68- IND- 32	Depth	Moisture density [1]		Mechanical analysis [2]		
						Percentage passing sieve—		
				Maximum dry density	Optimum moisture	3/4 inch	3/8 inch	No. 4 (4.7 mm)
			Inches	*Pounds per cubic foot*	*Percent*			
Coupee silt loam:								
SW¼NE¼ sec. 30, T. 38 N., R. 1 E.	Outwash (Wisconsin outwash plain).	1-1	0-10	92	15	----------	----------	----------
		1-5	26-33	113	15	100	99	99
		1-11	60-72	113	13	----------	100	85
Quinn loam:								
NE corner sec. 5, T. 37 N., R. 1 E.	Outwash (Wisconsin outwash plain).	2-1	0-4	84	26	----------	----------	100
		2-5	19-27	118	12	----------	100	97
		2-9	47-72	107	15	----------	----------	100

[1] Based on AASHTO Designation T 99-57, Method C (*1*).

[2] Mechanical analyses according to AASHTO Designation T 88-57 (*1*). Results by this procedure frequently may differ from results obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHTO procedure, the fine material is analyzed by the hydrometer method, and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS procedure, the fine material is analyzed by the pipette method, and the

TABLE 6.—*Estimated soil properties*

[Alluvial land (Am), Gravl pits (GP), Made land (Ma), and Marsh (Mc) are not listed because their properties

Soil series and map symbols	Depth to seasonal high water table	Depth from surface	Dominant USDA texture	Classification	
				Unified	AASHTO
	Feet	*Inches*			
Adrian: Ad	0-1	0-21	Muck	Pt	----------
		21-60	Fine sand, sand	SW-SM or SM	A-3
Alida: AeA	1-3	0-9	Loam	CL-ML or CL	A-4 or A-6
		9-33	Gravelly loam and clay loam.	CL, ML, SM, or SC	A-6 or A-7
		33-64	Gravelly loamy sand and sand.	SW-SM or SC	A-1 or A-3
Aubbeenaubbee: Au	1-3	0-21	Sandy loam	SM	A-2-4 or A-4
		21-26	Sandy clay loam	SC or CL	A-6
		26-60	Clay loam	CL or ML	A-6 or A-7
		60-74	Loam	CL	A-4 or A-6
Blount: BbA	1-3	0-10	Silt loam	ML, CL-ML, or CL	A-4 or A-6
		10-17	Silty clay loam	CL	A-6 or A-7
		17-60	Silty clay, silty clay loam.	CL or CH	A-7
Brady: Bd	1-3	0-34	Sandy loam	SM, SW-SM, or SM-SC	A-2-4 or A-4
		34-60	Loamy sand and sand	SW-SM or SM	A-1-b or A-3

test data

Department and the Bureau of Public Roads according to standard procedures of the American Association of State Highway and table 6. These soils contain soft shale fragments which are broken down into sand- and silt-sized particles by mechanical manipula-

Mechanical analysis [2]—Continued							Liquid limit	Plasticity index	Classification	
Percentage passing sieve—Cont.			Percentage smaller than—							
No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)	0.05 mm	0.02 mm	0.005 mm	0.002 mm			AASHTO [3]	Unified [4]
							Percent			
100	97	88	84	68	39	25	36	9	A–4 (8)	ML
98	80	52	51	46	31	25	32	16	A–6 (6)	CL
73	40	9	9	8	8	7	----------	[5] NP	A–1–b (0)	SW–SM
99	90	56	52	40	22	15	40	NP	A–4 (4)	ML
94	83	60	48	31	22	19	23	3	A–4 (5)	CL–ML
98	71	10	10	10	10	9	----------	NP	A–3	SW

material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analyses used in this table are not suitable for use in naming textural classes of soils.

[3] Based on AASHTO Designation M 145–49 (*1*).

[4] Based on the Unified Soil Classification System (*2*).

[5] NP means nonplastic.

significant in engineering

are too variable for reliable estimates to be made. The symbol > means more than; the symbol < means less than]

Percentage passing sieve—			Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Potential frost action [1]	Shrink-swell potential
No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							
			Percent		*Inches per hour*	*Inches per inch of soil*	*pH*		
----------	----------	----------	<10	[2] NP	6.0–20	0.35–0.45	4.5–5.5	High----------	----------
70–100	35–80	5–30	----------	----------	6.0–20	0.05–0.07	4.5–7.3	----------	Low.
100	85–95	60–75	20–30	10–20	0.6–2.0	0.20–0.22	5.6–7.3	High----------	Low.
70–90	60–90	40–70	25–50	15–25	0.6–2.0	0.15–0.19	5.1–6.5	----------	Moderate.
65–95	35–70	5–30	<2	NP	>20	0.05–0.10	5.1–5.5	----------	Low.
100	60–70	30–40	5–15	NP–6	6.0–20	0.13–0.15	5.6–7.3	High----------	Very low.
100	80–90	35–55	25–35	10–15	0.6–2.0	0.16–0.18	5.6–6.0	----------	Low.
100	90–100	70–80	35–50	15–25	0.6–2.0	0.15–0.19	6.6–7.8	----------	Moderate.
85–90	70–85	50–65	25–35	10–20	0.6–2.0	0.05–0.19	7.9–8.4	----------	Low.
95–100	85–100	65–90	25–35	5–15	0.6–2.0	0.22–0.24	5.1–6.0	High----------	Low.
95–100	90–100	80–95	35–50	20–30	0.06–0.2	0.18–0.20	4.5–5.5	----------	Moderate.
90–100	90–100	85–95	45–60	25–35	0.06–0.2	0.11–0.13	4.5–8.4	----------	Moderate.
85–95	50–65	25–40	5–15	2–7	2.0–6.0	0.13–0.15	5.1–7.3	----------	Low.
85–95	40–70	5–30	<5	NP	>20	0.05–0.07	5.1–6.5	Low----------	Very low.

TABLE 6.—*Estimated soil properties*

Soil series and map symbols	Depth to seasonal high water table	Depth from surface	Dominant USDA texture	Classification	
				Unified	AASHTO
	Feet	*Inches*			
Brems: BeA	2–4	0–60	Fine sand	SM	A–2–4
Brookston: Br	0–1	0–15	Silty clay loam	CL	A–6
		15–46	Clay loam	CL or ML	A–6 or A–7
		46–75	Loam	CL	A–4 or A–6
Chelsea: ChA, ChC	>6	0–6	Fine sand	SM	A–2–4
		6–33	Fine sand	SM	A–2–4
		33–87	Fine sand	SM	A–2–4
Coupee: CoA	>6	0–14	Silt loam	ML, CL–ML, or CL	A–4 or A–6
		14–33	Silt loam or clay loam	CL or ML	A–6
		33–52	Stratified loamy sand, sand, and coarse sand.	SW–SM or SM	A–1–6 or A–3
		52–98	Stratified fine medium and coarse sand, and fine gravel.	GW–GM	A–1–a
Crosier: CtA, CtB	1–3	0–11	Loam	CL	A–4 or A–6
		11–30	Clay loam	CL or ML	A–6 or A–7
		30–60	Loam	CL	A–4 or A–6
Del Rey: De	1–3	0–9	Silt loam	ML, CL, or CL–ML	A–4 or A–6
		9–36	Silty clay	CL, CH, or MH	A–7
		36–48	Loam and silt loam	CL–ML, CL, or ML	A–4 or A–6
		48–72	Stratified silt loam, silty clay loam.	ML or CL	A–6 or A–7
Edwards: Ed	0–1	0–30	Muck	Pt	
		30–52	Marl		
Elston: EsA	>6	0–13	Sandy loam	SM	A–2–4 or A–4
		13–24	Gravelly sandy clay, loam, and gravelly sandy loam.	SC	A–2–6 or A–6
		24–60	Loamy sand and gravelly sand.	SM or SW–SM	A–1–a
Fox: FsA, FsB	>6	0–12	Sandy loam and gravelly sandy loam.	SM or SM–SC	A–2–4 or A–4
		12–26	Gravelly sandy clay loam and sandy loam.	SC	A–2–6 or A–6
		26–38	Gravelly clay loam	CL	A–6
		38–60	Gravel and coarse sand	GP, GW–GM, SW–SM, SW, SP	A–1
Gilford: Gf	0–1	0–14	Sandy loam	SC or SM–SC	A–4 or A–2–4
		14–32	Loamy sand, sandy loam.	SC or SM–SC	A–2, A–2–4, or A–4
		32–60	Sand	SW–SM or SM	A–1–b or A–3
Hillsdale: HdA, HdB, HeC2, HeD2	>6	0–12	Sandy loam	SC or SM–SC	A–2–4 or A–4
		12–24	Sandy clay loam	SC	A–4 or A–6
		24–52	Sandy loam	SC or SM–SC	A–2–4 or A–4
		52–63	Loamy sand	SW–SM, SM, or SM–SC	A–2–4 or A–1–b
		63–72	Sandy loam	SC or SM–SC	A–2–4 or A–4
Houghton: Hm, Ho	0–1	0–54	Muck	Pt	
		54–60	Sand	SP	A–3 or A–2–4
Landes: La	3–6	0–23	Loam	CL	A–6
		23–33	Sandy loam	SM or SM–SC	A–2–4 or A–4
		33–60	Medium and coarse sand.	SW–SM or SM	A–1–b or A–3
Martinsville: MeA, MeB2, MeC2	>6	0–11	Loam	CL	A–6
		11–22	Sandy clay loam	SM, SM–SC, SC, or CL	A–2–4, A–4, or A–6
		22–37	Loam	CL	A–6
		37–60	Stratified silt and sand	SW–SM, SM, or SM–SC	A–2–4, A–3, or A–4

significant in engineering—Continued

Percentage passing sieve—			Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Potential frost action [1]	Shrink-swell potential
No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							
			Percent		*Inches per hour*	*Inches per inch of soil*	*pH*		
85–95	55–75	15–35	<2	NP	>20	0.05–0.09	5.1–6.5	Low	Very low.
100	95–100	85–95	35–50	20–30	0.6–2.0	0.21–0.23	6.1–7.3	High	Moderate.
95–100	85–100	65–80	35–50	15–25	0.6–2.0	0.15–0.19	6.6–7.8		Moderate.
85–95	70–90	50–70	25–35	10–20	0.6–2.0	0.17–0.19	7.9–8.4		Moderate.
100	65–80	20–35	<2	NP	6.0–20	0.06–0.09	5.1–6.0	Low	Very low.
100	65–80	20–35	<2	NP	>20	0.06–0.08	5.6–6.0		Very low.
100	65–80	20–35	<2	NP	>20	0.05–0.07	5.6–6.0		Very low.
95–100	85–100	65–90	25–35	5–15	0.6–2.0	0.20–0.24	5.6–7.3	Moderate	Low.
90–95	85–95	70–90	30–40	10–20	0.6–2.0	0.15–0.19	5.1–6.0		Low.
75–85	40–65	5–15	<2	NP	6.0–20	0.05–0.07	5.1–5.5		Low.
30–40	15–30	2–10	<2	NP	>20	0.02–0.04	5.1–5.5		Low.
100	85–95	60–75	25–35	10–20	0.6–2.0	0.20–0.22	6.1–7.3	High	Low.
95–100	85–100	65–80	35–50	15–25	0.2–0.6	0.15–0.19	6.1–7.3		Moderate.
85–95	70–90	50–70	25–35	10–20	0.2–0.6	0.05–0.19	7.9–8.4		Low.
95–100	85–100	65–90	25–35	5–15	0.6–2.0	0.22–0.24	5.1–6.5	High	Low.
95–100	90–100	85–95	45–60	25–35	0.06–0.20	0.18–0.20	5.6–6.0		Moderate.
95–100	80–100	60–90	25–40	5–20	0.06–0.20	0.17–0.19	6.1–7.3		Low.
95–100	85–100	65–95	25–50	10–30	0.06–0.20	0.19–0.21	7.9–8.4		Low.
					6.0–20	0.35–0.45	5.6–7.3	High	
					([3])	([3])	7.9–8.4		Low.
100	60–70	30–40	<30	NP–6	2.0–6.0	0.13–0.15	5.6–7.3	Moderate	Low.
85–95	60–70	30–40	25–35	11–16	2.0–6.0	0.12–0.14	6.6–7.3		Low.
40–55	15–30	5–15	<2	NP	>20	0.05–0.07	7.9–8.4		Very low.
75–95	45–65	20–40	<30	NP–6	0.6–2.0	0.13–0.15	6.1–7.3	Moderate	Low.
70–90	45–80	20–50	25–35	11–16	0.6–2.0	0.16–0.18	6.6–7.3		Low.
70–80	60–80	50–65	30–40	20–30	0.6–2.0	0.15–0.19	7.4–7.8		Moderate.
40–65	20–45	2–10	<2	NP	6.0–20	0.02–0.04	7.9–8.4		Very low.
90–100	55–70	30–40	20–30	4–10	2.0–6.0	0.13–0.15	6.1–7.3	High	Very low.
90–100	50–70	30–40	20–30	4–10	2.0–6.0	0.12–0.14	5.6–6.5		Very low.
85–100	45–75	5–25	<2	NP	6.0–20	0.05–0.07	6.6–8.4		Very low.
80–95	50–65	25–40	20–30	4–10	2.0–6.0	0.13–0.15	5.6–6.5	Moderate	Low.
80–95	65–85	35–50	25–35	10–15	0.6–2.0	0.16–0.18	6.1–6.5		Low.
80–95	50–65	25–40	20–30	4–10	0.6–2.0	0.12–0.14	5.6–6.5		Low.
80–95	40–70	10–30	<12	NP–6	2.0–6.0	0.09–0.11	6.1–6.5		Low.
80–95	50–65	25–40	20–30	4–10	2.0–6.0	0.11–0.13	6.6–7.3		Low.
					6.0–20	0.35–0.45	4.5–6.5	High	
90–100	50–70	5–15	<2	NP	>20	0.05–0.07	6.1–6.5		Low.
95–100	80–95	55–75	25–35	10–20	2.0–6.0	0.20–0.22	6.6–7.2	Moderate	Low.
90–100	55–70	25–40	15–30	NP–6	2.0–20	0.11–0.13	7.9–8.4		Low.
90–100	45–70	5–15	<2	NP	6.0–20	0.05–0.07	7.9–8.4		Very low.
95–100	85–100	60–75	25–35	10–20	0.6–2.0	0.20–0.22	5.6–7.3	Moderate	Low.
95–100	75–90	30–55	20–35	5–15	0.6–2.0	0.16–0.18	6.1–6.5		Low.
95–100	85–100	60–75	25–35	10–20	0.6–2.0	0.17–0.19	5.6–6.0		Moderate.
90–100	50–70	5–50	<30	NP–10	2.0–6.0	0.19–0.21	6.6–7.3		Low.

TABLE 6.—*Estimated soil properties*

Soil series and map symbols	Depth to seasonal high water table	Depth from surface	Dominant USDA texture	Classification	
				Unified	AASHTO
	Feet	*Inches*			
Maumee: Mf, Mg	0–1	0–14	Loamy fine sand	SM or SM–SC	A–2–4
		14–65	Fine sand and sand	SW–SM or SM	A–3 or A–2–4
Metea: MkB	>6	0–20	Loamy fine sand	SM or SM–SC	A–2–4
		20–34	Sand	SW–SM or SM	A–3
		34–50	Sandy clay loam and clay loam.	CL or SC	A–6 or A–7
		50–72	Loam	CL or CL–ML	A–4 or A–6
Miami: MmB, MmC2, MoC3, MoD3	>6	0–14	Loam	ML or CL	A–6
		14–38	Clay loam	CL	A–6 or A–7
		38–60	Loam	CL–ML or CL	A–4 or A–6
Milford: Mp	0–1	0–15	Silty clay loam	CL	A–6 or A–7
		15–46	Silty clay loam	CL or CH	A–7
		46–59	Loam	CL	A–4 or A–6
		59–72	Stratified clay loam, loam, and sandy loam.	SM, SC, ML, or CL	A–6 or A–7
Morley: MrB2, MrC2, MsD3	>6	0–5	Silt loam	ML, CL–ML, or CL	A–4 or A–6
		5–38	Silty clay loam, silty clay.	CL or CH	A–7
		38–60	Clay loam	CL or ML	A–6 or A–7
Oshtemo: OsA, OsB, OsC2, OsD	>6	0–16	Sandy loam	SM or SM–SC	A–2–4 or A–4
		16–28	Gravelly sandy clay loam.	SC	A–2–4 or A–2–6
		28–54	Loamy sand	SW–SM or SM	A–2–4 or A–3
		54–60	Stratified sand and gravelly sand.	SW, SP, GW, GP, or GW–GM	A–1–b
Palms: Pa	0–1	0–21	Muck	Pt	
		21–26	Loam	CL	A–4 or A–6
		26–40	Clay loam	CL or ML	A–6
		40–60	Sandy loam	SM or SM–SC	A–2–4
Quinn: Qu	0–1	0–12	Loam	CL	A–4
		12–42	Sandy loam	SM–SC, SC, or CL	A–2–4 or A–4
		42–47	Loam	CL	A–4
		47–72	Loamy sand and sand	SW–SM, SM–SC, or SM	A–1–b or A–3
Rensselaer: Re, Rm	0–1	0–17	Loam	CL	A–6
		17–26	Clay loam	CL	A–6 or A–7
		26–41	Stratified sandy loam, loamy sand, and sandy clay loam.	SM–SC, SC, CL–ML or CL	A–2–4, A–2–6, or A–4
		41–60	Gravelly loamy sand	SM or SM–SC	A–2–4
Riddles: RtA, RtB, RtC2, RtD2	>6	0–12	Loam	CL	A–4
		12–46	Clay loam	CL	A–6 or A–7
		46–72	Loam	ML	A–4
Tedrow: Te	1–3	0–10	Fine sand	SM	A–3
		10–60	Sand	SW–SM or SM	A–1–b or A–3
Tracy: TrA, TrB, TrC2	>6	0–9	Sandy loam	SM or SM–SC	A–2–4 or A–4
		9–22	Loam	CL	A–6
		22–32	Sandy loam, gravelly sandy loam.	SM–SC or SC	A–2–4
		32–60	Gravelly loamy sand, sand.	SM or SW–SM	A–1–b or A–3
Troxel: Tx	>6	0–58	Silt loam	ML, CL, or CL–ML	A–4 or A–6
		58–70	Clay loam	CL or ML	A–6 or A–7
		70–80	Sandy loam	SM, SC, or SM–SC	A–2–4 or A–4
		80–91	Loam	CL	A–6
Tyner: TyA, TyC, TyD	>6	0–44	Loamy sand	SM	A–1–b or A–3
		44–70	Sand	SP	A–1–b or A–3

significant in engineering—Continued

Percentage passing sieve—			Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Potential frost action [1]	Shrink-swell potential
No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)	*Percent*		*Inches per hour*	*Inches per inch of soil*	*pH*		
95–100	50–75	15–30	<10	NP–6	6.0–20	0.10–0.12	6.1–7.3	Moderate	Very low.
95–100	50–80	5–30	<2	NP	>20	0.05–0.07	6.6–7.3		Very low.
100	50–75	15–30	<10	NP–6	>20	0.10–0.12	5.6–7.3	Moderate	Low.
85–95	40–65	5–15	<2	NP	>20	0.06–0.08	6.6–7.3		Low.
80–90	65–90	35–70	25–50	10–25	0.6–2.0	0.16–0.18	5.6–6.0		Moderate.
80–90	70–85	50–70	15–30	5–15	0.6–2.0	0.17–0.19	7.9–8.4		Low.
85–100	75–95	50–75	25–35	10–20	0.6–2.0	0.15–0.22	6.1–7.3		Low.
85–100	75–100	60–80	35–50	15–25	0.6–2.0	0.15–0.19	5.6–7.8		Moderate.
80–90	70–85	50–70	15–30	5–15	0.2–2.0	0.17–0.19	7.9–8.4		Low.
100	95–100	85–95	35–50	20–30	0.2–0.6	0.21–0.23	6.1–6.5	High	Moderate.
100	95–100	85–95	40–60	25–35	0.2–0.6	0.18–0.20	7.4–7.8		High.
100	85–95	60–75	25–35	10–20	0.2–0.6	0.17–0.19	7.9–8.4		Low.
100	70–95	40–75	35–50	15–30	0.6–2.0	0.19–0.21	7.9–8.4		Low.
95–100	85–100	65–90	25–40	5–15	0.6–2.0	0.22–0.24	5.6–6.5	Moderate	Moderate.
90–100	85–100	65–95	45–60	25–35	0.06–0.2	0.11–0.13	6.1–6.5		Moderate.
75–95	70–100	50–75	35–50	15–25	0.2–0.6	0.14–0.16	7.9–8.4		Moderate.
80–95	50–65	25–40	20–30	4–10	2.0–6.0	0.13–0.15	5.6–7.3	Moderate	Low.
70–90	40–65	20–35	25–35	10–15	2.0–6.0	0.12–0.14	5.1–5.5		Low.
60–95	30–70	10–30	<10	NP–6	2.0–6.0	0.09–0.11	5.6–7.3		Very low.
35–70	20–50	2–10	<2	NP	6.0–20	0.05–0.07	7.9–8.4		Very low.
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95–100	80–100	60–75	25–35	10–20	0.6–2.0	0.17–0.19	5.6–6.0	High	Low.
95–100	85–100	65–80	35–50	15–25	0.6–2.0	0.14–0.16	5.6–6.0		Low.
95–100	55–70	25–40	20–30	4–10	0.6–2.0	0.11–0.13	6.6–7.3		Low.
90–100	75–95	55–75	25–35	10–20	0.6–2.0	0.20–0.22	4.5–5.5	High	Low.
85–95	50–85	25–60	20–30	4–10	0.6–2.0	0.12–0.14	4.5–5.0		Very low.
85–95	70–90	50–70	25–35	10–20	0.6–2.0	0.17–0.19	5.1–5.5		Low.
70–100	35–75	5–30	<10	NP–6	6.0–20	0.06–0.08	6.1–7.3		Very low.
100	85–95	60–75	25–35	10–20	0.6–2.0	0.20–0.22	6.1–7.3	High	Low.
100	90–100	70–80	35–50	15–25	0.06–0.2	0.15–0.19	6.6–7.3		Moderate.
85–100	55–85	30–55	5–25	5–15	0.06–0.2	0.11–0.17	6.6–7.8		Moderate.
65–85	35–65	10–25	<10	NP–6	6.0–20	0.08–0.10	7.9–8.4		Very low.
85–95	75–90	50–70	25–35	10–20	0.6–2.0	0.20–0.22	6.1–7.3	Moderate	Low.
85–95	80–95	60–75	35–50	15–25	0.6–2.0	0.15–0.19	5.6–6.5		Moderate.
80–90	70–85	50–70	25–35	10–20	0.6–2.0	0.17–0.19	6.1–7.8		Low.
95–100	60–80	20–35	<2	NP	6.0–20	0.07–0.09	6.1–7.3	Low	Very low.
95–100	45–70	5–15	<2	NP	6.0–20	0.06–0.08	5.6–7.3		Very low.
90–100	55–70	25–40	20–30	4–10	2.0–6.0	0.13–0.15	5.6–6.5	Moderate	Low.
90–100	75–95	55–75	25–35	10–20	0.6–2.0	0.17–0.19	5.6–6.5		Low.
75–85	45–60	25–35	<25	5–10	0.6–2.0	0.12–0.14	5.1–5.5		Low.
60–70	30–50	5–20	<2	NP–6	>20	0.02–0.08	5.6–6.5		Very low.
100	90–100	70–90	25–35	5–15	0.6–2.0	0.20–0.22	5.1–6.0	High	Low.
95–100	85–100	65–80	35–50	15–25	0.6–2.0	0.15–0.19	5.1–5.5		Moderate.
85–95	50–65	25–40	20–30	4–10	0.6–2.0	0.12–0.14	5.6–6.0		Very low.
80–90	65–85	50–65	25–35	10–20	0.6–2.0	0.17–0.19	5.6–6.0		Low.
85–95	45–70	10–30	<10	NP–6	6.0–20	0.10–0.12	5.1–6.5	Low	Very low.
70–90	35–60	5–15	<2	NP	>20	0.05–0.07	5.6–6.0		Very low.

TABLE 6.—*Estimated soil properties*

Soil series and map symbols	Depth to seasonal high water table	Depth from surface	Dominant USDA texture	Classification	
				Unified	AASHTO
	Feet	*Inches*			
Wallkill: Wk	0–1	0–32	Silt loam, loam, and sandy loam.	CL, CL–ML, or ML	A–4 or A–6
		32–52	Muck	Pt	A–7
Washtenaw: Ws	0–1	0–23	Silt loam	CL, CL–ML, or ML	A–4 or A–6
		23–48	Silty clay loam	CL	A–6 or A–7
		48–60	Silt loam and loam	CL, CL–ML, or ML	A–4 or A–6
Whitaker: Wt	1–3	0–11	Loam	CL	A–6
		11–44	Clay loam	CL or ML	A–6 or A–7
		44–60	Stratified silt and sand	SW–SM, SM–SC, or SC	A–3, A–2–4, or A–4

[1]Ratings for potential frost action are for the entire soil profile, not for each layer.
[2] NP means nonplastic.

TABLE 7.—*Interpretations of engineering*

[Alluvial land (Am), Gravel pits (GP), Made land (Ma), and Marsh (Mc) are not listed in the table

Soil series and map symbols	Suitability as a source of—			Soil features affecting—
	Topsoil	Sand and gravel	Road fill	Embankments, dikes, and levees
Adrian: Ad	Poor: very high organic-matter content; very poorly drained.	Fair: sand below muck; no gravel.	Poor: unstable; very high compressibility.	Very high organic-matter content; underlying material is sand.
Alida: AeA	Good	Not suitable	Good: somewhat poorly drained; moderate shrink-swell potential; high susceptibility to frost action; medium to low shear strength; fair to good compaction characteristics; medium compressibility; seasonal high water table.	Fair stability; fair to good compaction characteristics; medium to low permeability when compacted; medium compressibility; medium susceptibility to piping.
Aubbeenaubbee: Au	Good	Poor in the surface layer; not suitable in the subsoil and underlying material.	Fair: medium to low shear strength; moderate to high susceptibility to frost action; low to moderate shrink-swell potential; fair to good compaction characteristics; fair stability; seasonal high water table.	Medium to low shear strength; fair stability, fair to good compaction characteristics; medium to low permeability when compacted; low to medium compressibility; medium susceptibility to piping.
Blount: BbA	Good	Not suitable	Poor: medium to low shear strength; moderate susceptibility to frost action; moderate shrink-swell potential; fair compaction characteristics; fair to good stability; seasonal high water table.	Medium to low shear strength; fair to good stability; fair compaction characteristics; low permeability when compacted; high to medium compressibility; low to medium susceptibility to piping.

significant in engineering—Continued

Percentage passing sieve—			Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Potential frost action [1]	Shrink-swell potential
No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)							
			Percent		*Inches per hour*	*Inches per inch of soil*	*pH*		
90–100	75–95	55–80	10–30	5–20	0.6–2.0	0.20–0.24	5.6–6.5	High	Low.
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100	90–100	70–90	25–35	5–15	0.2–0.6	0.22–0.24	6.1–7.3	High	Moderate.
95–100	90–100	80–95	35–50	20–30	0.06–0.2	0.18–0.20	6.6–7.3	---	Moderate.
85–95	75–95	55–85	25–35	5–20	0.6–2.0	0.17–0.19	6.6–7.8	---	Moderate.
95–100	80–95	55–75	25–35	10–20	0.6–2.0	0.20–0.22	5.6–7.3	High	Low.
95–100	85–100	65–80	35–50	15–25	0.6–2.0	0.15–0.19	5.6–6.5	---	Moderate.
95–100	50–100	5–50	5–10	5–10	2.0–6.0	0.19–0.21	6.6–7.3	---	Low.

[1] Variable.

properties of the soils

because their properties are too variable for reliable interpretations to be made]

Soil features affecting—Continued			
Pond reservoir areas	Drainage for crops and pasture	Terraces and diversions	Greased waterways
High water table; very poorly drained.	Very poorly drained; seasonal high water table at a depth of 0 to 1 foot; rapid permeability.	Not needed, except to divert surface runoff from adjoining higher areas.	Generally not needed, except where a concentrated flow of surface water is received from adjoining higher areas.
Moderate seepage rate in substratum; seasonal high water table; nearly level.	Somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; moderate permeability.	Not needed, except to divert surface runoff from adjoining higher areas.	Generally not needed, except where a concentrated flow of surface water is received from adjoining higher areas.
Moderate: seepage in substratum; seasonal high water table; nearly level.	Somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet.	Not needed, except to divert surface runoff from adjoining higher areas.	Generally not needed, except where a concentrated flow of surface water is received from higher areas.
Slow seepage rate; seasonal high water table at a depth of 1 to 3 feet; nearly level.	Somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet.	Not needed, except to divert surface runoff received from adjoining higher areas; clayey subsoil.	Difficult to vegetate because of clayey subsoil.

TABLE 7.—*Interpretations of enginering*

Soil series and map symbols	Suitability as a source of—			Soil features affecting—
	Topsoil	Sand and gravel	Road fill	Embankments, dikes, and levees
Brady: Bd	Good	Good for sand; little gravel.	Poor: medium shear strength; high susceptibility to frost action; very low shrink-swell potential; fair to good compaction characteristics; fair stability; seasonal high water table.	Medium shear strength; fair stability; good compaction characteristics; medium to low permeability when compacted; low to medium compressibility; moderate to high susceptibility to piping.
Brems: BeA	Poor: sandy material.	Good for sand; little gravel.	Good: medium shear strength; low susceptibility to frost action; very low shrink-swell potential; good compaction characteristics.	Medium shear strength; fair stability; good compaction characteristics; high permeability when compacted; low compressibility; medium to high susceptibility to piping.
Brookston: Br	Poor: very poorly drained; too clayey.	Not suitable	Poor: medium to low shear strength; high susceptibility to frost action; moderate shrink-swell potential; fair to good compaction characteristics; seasonal high water table.	Medium to low shear strength; fair to poor stability; fair to good compaction characteristics; low permeability when compacted; medium compressibility; low to medium susceptibility to piping.
Chelsea: ChA, ChC	Poor	Fair for sand; little gravel.	Good: medium shear strength; low susceptibility to frost action; very low shrink-swell potential; fair stability; good compaction characteristics.	Medium shear strength; fair stability; good compaction characteristics; high permeability when compacted; low compressibility; medium to high susceptibility to piping.
Coupee: CoA	Good	Not suited in subsoil; fair in underlying material.	Good: medium to low shear strength; moderate to low susceptibility to frost action; low shrink-swell potential; good compaction characteristics; fair stability.	Medium to low shear strength; fair stability; good compaction characteristics; medium permeability when compacted; low to medium compressibility; medium to high susceptibility to piping.
Crosier: CtA, CtB	Good	Not suitable	Poor: medium to low shear strength; high susceptibility to frost action; moderate shrink-swell potential; fair to good compaction characteristics; seasonal high water table.	Medium to low shear strength; fair to poor stability; fair compaction characteristics; medium to low permeability when compacted; medium compressibility; medium susceptibility to piping.
Del Rey: De	Good	Not suitable	Poor: medium to low shear strength; high susceptibility to frost action; moderate shrink-swell potential; fair to good compaction characteristics; seasonal high water table.	Medium to low shear strength; fair to poor stability; fair compaction characteristics; medium to low permeability when compacted; medium compressibility; medium to high susceptibility to piping.
Edwards: Ed	Poor: very high organic-matter content; very poorly drained.	Not suitable	Not suitable: very high compressibility; underlying marl is unstable.	Organic material is pervious; marl is unstable.

properties of the soils—Continued

Soil features affecting—Continued			
Pond reservoir areas	Drainage for crops and pasture	Terraces and diversions	Greased waterways
Rapid seepage rate; seasonal high water table at a depth of 1 to 3 feet; nearly level.	Somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet.	Not needed: nearly level; sandy material.	Not needed: nearly level; sandy material.
Rapid seepage rate; nearly level.	Moderately well drained	Not needed: nearly level; slow surface runoff.	Not needed: nearly level; slow surface runoff.
Moderate to slow seepage rate; seasonal high water table at a depth of 1 to 3 feet.	Very poorly drained; seasonal high water table at a depth of 0 to 1 foot.	Not needed: level and depressional.	Not needed: level and depressional.
Not suitable; rapid seepage rate; nearly level and moderately sloping.	Excessively drained	Not needed: slow surface runoff.	Not needed: slow surface runoff.
Not suitable; rapid seepage rate; nearly level.	Well drained	Not needed: slow surface runoff.	Not needed: slow surface runoff.
Moderate seepage rate in subsoil; seasonal high water table at a depth of 1 to 3 feet; nearly level and gently sloping.	Somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet.	Not needed, except to divert surface runoff received from adjoining higher areas.	Generally not needed, except when a concentrated flow of surface water is received from adjoining higher areas.
Slow seepage rate; seasonal high water table at a depth of 1 to 3 feet; nearly level.	Somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet.	Not needed, except to divert surface runoff received from adjoining higher areas.	Generally not needed, except when a concentrated flow of surface water is received from adjoining higher areas.
Variable seepage rate; high water table.	Very poorly drained	Not needed: depressional; high water table.	Not needed: depressional; high water table.

TABLE 7.—*Interpretations of enginering*

Soil series and map symbols	Suitability as a source of—			Soil features affecting—
	Topsoil	Sand and gravel	Road fill	Embankments, dikes, and levees
Elston: EsA	Good	Not suitable in subsoil; good in the underlying material.	Good: medium to low shear strength; moderate susceptibility to frost action; low shrink-swell potential; good to fair compaction characteristics.	Medium to low shear strength; fair stability; good to fair compaction characteristics; medium to low permeability; medium to low permeability when compacted; low to medium compressibility; medium susceptibility to piping.
Fox: FsA, FsB	Good	Good below a depth of 36 to 42 inches.	Fair: medium to low shear strength; moderate susceptibility to frost action; moderate to low shrink-swell potential; fair to good compaction characteristics.	Medium to low shear strength; fair stability; fair to good compaction characteristics; medium to low permeability when compacted; medium to low compressibility; medium to low susceptibility to piping.
Gilford: Gf	Poor: very poorly drained.	Fair: very poorly drained.	Poor: medium shear strength; high susceptibility to frost action; very low shrink-swell potential; good compaction characteristics; seasonal high water table.	Medium shear strength; fair stability; good compaction characteristics; medium permeability when compacted; low to medium compressibility; medium to high susceptibility to piping.
Hillsdale: HdA, HdB, HeC2, HeD2.	Good	Not suitable	Good: medium shear strength; moderate susceptibility to frost action; low shrink-swell potential; fair to good compaction characteristics.	Medium shear strength; fair to poor stability; good compaction characteristics; medium permeability when compacted; medium to low compressibility; medium to high susceptibility to piping.
Houghton: Hm, Ho	Poor: very poorly drained; very high organic-matter content.	Not suitable	Not suitable: very high organic-matter content.	Not suitable: very high organic-matter content.
Landes: La	Good to a depth of 33 inches.	Not suitable	Fair: medium to low shear strength; moderate to low susceptibility to frost action; low shrink-swell potential; fair to good compaction characteristics.	Medium to low shear strength; fair stability; good to fair compaction characteristics; medium permeability when compacted; low compressibility.
Martinsville: MeA, MeB2, MeC2.	Good	Not suitable	Fair: medium to low shear strength; moderate to high susceptibility to frost action; low shrink-swell potential; fair to good compaction characteristics.	Medium to low shear strength; fair stability; fair to good compaction characteristics; low to medium permeability; medium susceptibility to piping.
Maumee: Mf, Mg	Poor: very poorly drained.	Fair: very poorly drained.	Poor: medium shear strength; moderate susceptibility to frost action; very low shrink-swell potential; good compaction characteristics; seasonal high water table.	Medium shear strength; fair stability; good compaction characteristics; medium to high permeability when compacted; low compressibility; medium to high susceptibility to piping.
Metea: MkB	Poor: loamy fine sand.	Fair in the surface layer; poor in the subsoil and underlying material.	Fair: medium to low shear strength; moderate susceptibility to frost action; low shrink-swell potential; fair compaction characteristics.	Medium to low shear strength; fair stability; fair compaction characteristics; medium to low permeability when compacted; medium to high susceptibility to piping.

properties of the soils—Continued

Soil features affecting—Continued			
Pond reservoir areas	Drainage for crops and pasture	Terraces and diversions	Greased waterways
Rapid seepage rate; nearly level.	Well drained	Not needed: nearly level; slow surface runoff.	Not needed: slow surface runoff.
Rapid seepage rate; nearly level to moderately sloping.	Well drained	Exposed substratum is difficult to vegetate.	Exposed substratum is difficult to vegetate.
Rapid seepage rate; seasonal high water table at a depth of 0 to 1 foot; subject to ponding.	Very poorly drained	Not needed: depressional	Not needed: depressional.
Moderate to rapid seepage rate; nearly level to strongly sloping.	Well drained	Short, irregular slopes that are more than 12 percent in places.	Most features favorable, depending on slope.
Variable seepage rate; high water table at a depth of 0 to 1 foot; depressional.	Very poorly drained	Not needed: depressional	Not needed: depressional.
Rapid seepage rate; subject to flooding.	Moderately well drained	Not needed: nearly level on flood plains.	Not needed: nearly level soil on flood plains.
Moderate seepage rate; nearly level to moderately sloping.	Well drained	Most features favorable, depending on slope.	Most features favorable, depending on slope.
Rapid seepage rate; seasonal high water table at a depth of 0 to 1 foot; subject to ponding.	Very poorly drained	Not needed: depressional	Not needed: depressional.
Moderate to rapid seepage rate; gently sloping.	Well drained	Most slopes are short and irregular.	Generally not needed.

TABLE 7.—*Interpretations of enginering*

Soil series and map symbols	Suitability as a source of—			Soil features affecting—
	Topsoil	Sand and gravel	Road fill	Embankments, dikes, and levees
Miami: MmB, MmC2, MoC3, MoD3.	Good	Not suitable	Fair: medium to low shear strength; moderate susceptibility to frost action; moderate to low shrink-swell potential; fair compaction characteristics.	Medium to low shear strength; fair stability; fair compaction characteristics; medium to low permeability when compacted; medium to low compressibility; medium to high susceptibility to piping.
Milford: Mp	Poor: poorly drained.	Not suitable	Poor: medium to low shear strength; high susceptibility to frost action; moderate shrink-swell potential; fair to poor compaction characteristics; seasonal high water table.	Medium to low shear strength; poor stability; fair compaction characteristics; low permeability when compacted; medium to high compressibility; low susceptibility to piping.
Morley: MrB2, MrC2, MsD3.	Good	Not suitable	Poor: medium to low shear strength; moderate susceptibility to frost action; moderate to high shrink-swell potential; fair to poor compaction characteristics.	Medium to low shear strength; fair to poor compaction characteristics; low permeability when compacted; medium to high compressibility; low susceptibility to piping.
Oshtemo: OsA, OsB, OsC2, OsD.	Good	Fair in subsoil; good for sand in underlying material.	Good: fair shear strength; moderate susceptibility to frost action; low to very low shrink-swell potential; good to fair compaction characteristics.	Fair shear strength; fair stability; good to fair compaction characteristics; medium to high permeability when compacted; low to medium compressibility; medium to high susceptibility to piping.
Palms: Pa	Poor: very high organic-matter content; very poorly drained.	Not suitable	Not suitable: organic material.	Not suitable: organic material.
Quinn: Qu	Poor: poorly drained.	Not suitable	Poor: medium to low shear strength; high susceptibility to frost action; low to very low shrink-swell potential; fair compaction characteristics; seasonal high water table.	Medium to low shear strength; fair stability; fair compaction characteristics; medium to low compressibility; high to medium susceptibility to piping.
Rensselaer: Re, Rm	Poor: very poorly drained.	Not suitable	Poor: medium to low shear strength; high susceptibility to frost action; low shrink-swell potential; fair to good compaction characteristics; seasonal high water table.	Medium to low shear strength; fair stability; fair to good compaction characteristics; medium to low compressibility; medium susceptibility to piping.
Riddles: RtA, RtB, RtC2, RtD2.	Good	Not suitable	Fair: medium to low shear strength; moderate susceptibility to frost action; moderate to low shrink-swell potential; fair compaction characteristics.	Medium to low shear strength: fair stability; fair compaction characteristics; medium to low permeability when compacted; medium to low compressibility; medium to high susceptibility to piping.
Tedrow: Te	Poor: sandy material.	Good for sand; very little gravel.	Fair: medium shear strength; low susceptibility to frost action; very low shrink-swell potential; good compaction characteristics; somewhat poorly drained.	Medium shear strength; fair stability; good compaction characteristics; high permeability when compacted; low compressibility; medium to high susceptibility to piping.

properties of the soils—Continued

Soil features affecting—Continued			
Pond reservoir areas	Drainage for crops and pasture	Terraces and diversions	Greased waterways
Moderate seepage rate; gently sloping to strongly sloping.	Well drained	Most features favorable	Most features favorable.
Slow seepage rate; high water table; depressional, in low areas.	Very poorly drained	Not needed: level and depressional.	Not needed: level and depressional.
Slow seepage rate; gently sloping to strongly sloping.	Well drained	All features favorable	All features favorable.
Rapid seepage rate; nearly level to strongly sloping.	Well drained	Generally not needed: sandy material; slow and medium surface runoff.	Generally not needed: sandy material; difficult to establish vegetation.
Variable seepage rate; high water table at a depth of 0 to 1 foot; level and depressional.	Very poorly drained	Not needed: level and depressional.	Not needed: level and depressional.
Moderate seepage rate; seasonal high water table at a depth of 0 to 1 foot; nearly level.	Poorly drained	Not needed: nearly level	Not needed: nearly level.
Moderate seepage rate; seasonal high water table at a depth of 0 to 1 foot; level and depressional.	Very poorly drained	Not needed: level and depressional.	Not needed: level and depressional.
Moderate seepage rate; nearly level to strongly sloping.	Well drained	Most features favorable	Most features favorable.
Rapid seepage rate; nearly level.	Somewhat poorly drained	Not needed: nearly level; slow surface runoff.	Not needed: nearly level; slow surface runoff.

TABLE 7.—*Interpretations of enginering*

Soil series and map symbols	Suitability as a source of—			Soil features affecting—
	Topsoil	Sand and gravel	Road fill	Embankments, dikes, and levees
Tracy: TrA, TrB, TrC2.	Good	Good for sand below a depth of 3 feet; little gravel.	Fair: medium to low shear strength; moderate susceptibility to frost action; low shrink-swell potential; good to fair compaction characteristics.	Medium to low shear strength; fair stability; good to fair compaction characteristics; medium to high permeability when compacted; low to medium compressibility; medium to high susceptibility to piping.
Troxel: Tx	Good	Not suitable	Poor: medium to low shear strength; high to moderate susceptibility to frost action; low shrink-swell potential; fair to good compaction characteristics.	Medium to low shear strength; fair stability; fair to good compaction characteristics; medium to low permeability when compacted; medium compressibility; medium susceptibility to piping.
Tyner: TyA, TyC, TyD.	Poor: sandy material.	Good for sand; not suitable for gravel.	Good: medium shear strength; low susceptibility to frost action; very low shrink-swell potential; good compaction characteristics.	Medium shear strength; fair stability; good compaction characteristics; high permeability when compacted; low compressibility; medium to high susceptibility to piping.
Wallkill: Wk	Poor: very poorly drained.	Not suitable	Poor: organic material; very poorly drained.	Subsoil and underlying material are organic.
Washtenaw: Ws	Poor: very poorly drained.	Not suitable	Poor: medium to low shear strength; high to moderate susceptibility to frost action; moderate shrink-swell potential; fair to poor compaction characteristics; very poorly drained.	Medium to low shear strength; fair to good stability; fair to good compaction characteristics; low permeability when compacted; medium to high compressibility; moderate susceptibility to piping.
Whitaker: Wt	Good	Not suitable	Poor: medium to low shear strength; high to moderate susceptibility to frost action; low shrink-swell potential; fair compaction characteristics; somewhat poorly drained.	Medium to low shear strength; fair stability; fair compaction characteristics; medium to low permeability when compacted; medium compressibility; medium susceptibility to piping.

out group index numbers, is given in table 6 for all soils mapped in St. Joseph County.

Engineering test data

Table 5 gives engineering test data for some of the major soil series in St. Joseph County. The engineering classifications in the table are based on results of mechanical analyses and tests to determine liquid limits and plastic limits. The mechanical analyses were made by combined sieve and hydrometer methods.

Moisture density (or compaction) data are important in earthwork. If a soil material is compacted at successively higher moisture content, assuming that the compactive effort remains constant, the density of the compacted material increases until the *optimum moisture content* is reached. After that, density decreases with increase in moisture content. The highest dry density obtained in the compactive test is the *maximum dry density*. As a rule, maximum strength of earthwork is obtained if the soil is compacted to the maximum dry density.

Liquid limit and plasticity index indicate the effect of water on the strength and consistence of soil material. As the moisture content of a dry clayey soil, from which the particles coarser than 0.42 millimeter have been removed, is increased, the material changes from a semisolid to a plastic.

If the moisture content is further increased, the

properties of the soils—Continued

Soil features affecting—Continued			
Pond reservoir areas	Drainage for crops and pasture	Terraces and diversions	Greased waterways
Rapid seepage rate; nearly level to moderately sloping.	Well drained	Most features favorable	Most features favorable.
Rapid seepage rate; depressional to nearly level.	Well drained	Not needed: depressional to nearly level.	All features favorable.
Rapid seepage rate; nearly level to strongly sloping.	Well drained	Not needed: sandy material; slow and medium surface runoff.	Not needed: sandy material; slow and medium surface runoff; difficult to vegetate.
Variable seepage rate; high water table.	Very poorly drained	Not needed: depressional and nearly level.	Not needed: depressional and nearly level.
Moderate to slow seepage rate; high water table at a depth of 0 to 1 foot; depressional to nearly level.	Very poorly drained	Not needed: depressional to nearly level.	Not needed: depressional to nearly level.
Moderate seepage rate; seasonal high water table at a depth of 1 to 3 feet; nearly level.	Somewhat poorly drained	Not needed except to divert surface runoff from adjoining higher areas.	Generally not needed except where a concentrated flow of surface water is received from adjoining higher areas.

material changes from a plastic to a liquid. The plastic limit is the moisture content at which the soil material changes from a semisolid to a plastic; and the liquid limit, from a plastic to a liquid. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of water content within which a soil material is plastic.

Soil properties significant in engineering

Several estimated soil properties significant in engineering are given in table 6. Evaluations are made for the typical profile of each soil series by layers significantly different. The estimates are based on field observations made in the course of mapping, on test data for the specified soils and similar soils, and on experience with the same kind of soils in other counties. Depth to bedrock is not included in this table because all the soils in St. Joseph County are so deep that bedrock does not affect their use. Following are explanations of some of the columns in table 6.

Depth to seasonal high water table is distance from the surface of the soil to the highest level that ground water reaches in the soil in most years.

Depth from surface is given in inches for horizons that have engineering properties significantly different from those of adjacent horizons.

Dominant USDA texture is described in table 6 in the standard terms used by the Department of Agri-

culture. These terms are based on the percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the soil contains gravel or other particles coarser than sand, an appropriate modifier is added, as for example, "gravelly loamy sand." "Sand," "silt," "clay," and some of the other terms used in USDA textural classification are defined in the "Glossary" of this soil survey.

The percentage of soil material that passes through specified sieves indicates the grain-size distribution in the soil.

Tests to determine liquid limit and plastic limit measure the effect of water on the consistence of soil material, as has been explained for table 5. Liquid limit and plasticity index are estimated in table 6, but in table 5 they are based on tests of soil samples.

Permeability is that quality of a soil that enables it to transmit water or air. Table 6 gives the rate at which the saturated soil transmits water in a vertical direction under a unit head of pressure. It is estimated on the basis of soil characteristics observed in the field, particularly structure, porosity, and texture. Lateral seepage and such transient soil features as plowpans and surface crusts are not considered.

Available water capacity is the capacity of soils to hold water for use by most plants. It is defined here as the difference between the amount of water in the soil at field capacity and the amount at the wilting point of most plants.

Reaction is the degree of acidity or alkalinity of a soil, expressed in pH values. The pH values and terms used to describe reaction are defined in the Glossary.

Potential frost action refers to the probable damage to structures caused by the freezing and thawing of soil material. This is an important factor in selecting sites for highways and runways and in planning any structure that is to be supported or abutted by soil that freezes.

Shrink-swell potential is the relative change in volume to be expected of soil material with changes in moisture content, that is, the extent to which the soil shrinks as it dries out or swells when it gets wet. The extent of shrinking and swelling is influenced by the amount and kind of clay in the soil. Shrinking and swelling of soil cause much damage to building foundations, roads, and other structures. A high shrink-swell potential indicates a hazard to maintenance of structures built in, on, or with material having this rating.

Engineering interpretations of the soils

The interpretations in table 7 are based on the engineering properties of soils shown in table 6, on test data for soils in this survey area and others nearby or adjoining, and on the experience of engineers and soil scientists with the soils of St. Joseph County. In table 7, ratings of good, fair, and poor are used to summarize suitability of the soils for topsoil, sand and gravel, and road fill. For all other uses, table 7 lists those soil features not to be overlooked in planning, installation, and maintenance.

Following are explanations of the columns in table 7.

Topsoil is used for topdressing an area where vegetation is to be established and maintained. Suitability is affected mainly by the ease of working and spreading the soil material, as for preparing a seedbed; the natural fertility of the material or the response of plants when fertilizer is applied; and the absence of substances toxic to plants. Texture of the soil material and its content of stone fragments are characteristics that affect suitability, and also considered in the ratings is damage that will result at the area from which topsoil is taken.

Sand and gravel are used in great quantities in many kinds of construction. The ratings in table 7 provide guidance about where to look for possible sources. A soil rated as a *good* or *fair* source of sand or gravel generally has a layer at least 3 feet thick, the top of which is within a depth of 6 feet. The ratings do not take into account thickness of overburden, location of the water table, or other factors that affect mining of the materials, and neither do they indicate the quality of the deposit.

Road fill is soil material used in embankments for roads. The suitability ratings reflect (1) the predicted performance of soil after it has been placed in an embankment that has been properly compacted and provided with adequate drainage and (2) the relative ease of excavating the material at borrow areas. The subsoil and underlying material are rated in the table.

Embankments, dikes, and levees require soil material resistant to seepage and piping and of favorable stability, shrink-swell potential, shear strength, and compactibility. Presence of stones or organic material in a soil are among features that are unfavorable. Only the subsoil and underlying material have been considered in table 7.

Pond reservoir areas hold water behind a dam or embankment. Soils suitable for pond reservoir areas have low seepage, which is related to their permeability and depth to fractured or permeable bedrock or other permeable material.

Drainage for crops and pasture is affected by such soil properties as permeability, texture, and structure; depth to claypan, rock, or other layers that influence rate of water movement; depth to the water table; slope; stability in ditchbanks; susceptibility to stream overflow; salinity or alkalinity; and availability of outlets for drainage.

Terraces and diversions are embankments or ridges constructed across the slope to intercept runoff so that it soaks into the soil or flows slowly to a prepared outlet. Features that affect suitability of a soil for terraces are uniformity of slope; and steepness; depth to bedrock or other unfavorable material; presence of stones; permeability; and resistance to water erosion, soil slipping, and soil blowing. A soil suitable for these structures has outlets for runoff and is not difficult to vegetate.

Grassed waterways are broad shallow channels that receive runoff water and carry it safely downslope to existing streams or water courses. Features that affect construction of waterways are slope, runoff, texture,

permeability, and resistance to water erosion. Also listed are features that affect the establishment and growth of plants.

Town and Country Planning

Residential, commercial, industrial, and institutional developments are growing in St. Joseph County as the suburbs of towns expand into the rural areas. This soil survey will help planning officials, developers, homeowners, and others in planning these developments and in solving problems that arise as the use of the land changes.

In table 8, the soils of St. Joseph County are rated for uses related to town and country development. The information in table 8 can be used, along with table 9 and with information in other parts of the survey, as a guide for planning. Before any construction projects are begun, however, an investigation should be made at the site being considered (fig. 14).

Figure 14.—**The house is on Oshtemo sandy loam, 0 to 2 percent slopes, and the pond is on Rensselaer loam.**

TABLE 8.—*Degree and kind of limitations of the*

[Alluvial land (Am), Gravel pits (GP), Made land (Ma), and Marsh (Mc) are not listed in the table

Soil series and map symbols	Building sites			
	Dwellings		Commercial or light industrial development	Landscaping and lawns
	With basements	Without basements		
Adrian: Ad	Severe: very poorly drained.	Severe: very poorly drained.	Severe: very high organic-matter content; very poorly drained; seasonal high water table at the surface or ponded.	Severe: very poorly drained; seasonal high water table at the surface or ponded.
Alida: AeA	Severe: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet.	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet.
Aubbeenaubbee: Au	Severe: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet.	Slight
Blount: BbA	Severe: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet.	Slight
Brady: Bd	Severe: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet.	Slight
Brems: BeA	Moderate: moderately well drained.	Slight	Slight	Slight
Brookston: Br	Severe: very poorly drained.	Severe: very poorly drained.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot or ponded.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot or ponded.
Chelsea:				
ChA	Slight	Slight	Slight	Slight
ChC	Moderate: slope	Moderate: slope	Severe: slope	Slight
Coupee: CoA	Slight	Slight	Slight	Slight
Crosier: CtA, CtB	Severe: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet.	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet.
Del Rey: De	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet.	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet.
Edwards: Ed	Severe: very poorly drained.	Severe: very poorly drained.	Severe: very high organic-matter content; very poorly drained; seasonal high water table at the surface or ponded.	Severe: very poorly drained; seasonal high water table at the surface or ponded; organic material.

soils for town and country development

because their properties are too variable for reliable interpretations to be made]

Building sites—Continued	Waste disposal systems		
Roads, streets, and parking lots	Septic tank absorption fields	Sewage lagoons	Sanitary landfill [1] (trench type)
Severe: very poorly drained; very high organic-matter content; very unstable.	Severe: very poorly drained; seasonal high water table at the surface or ponded.	Severe: very poorly drained; very high organic-matter content; seasonal high water table at the surface or ponded.	Severe: very high organic-matter content; cannot provide satisfactory cover; very poorly drained; seasonal high water table at the surface or ponded.
Severe: high susceptibility to frost action.	Severe: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet.	Severe: rapidly permeable material at a depth of less than 5 feet; moderate hazard of effluent seepage.	Severe: rapidly permeable sand and gravel at a depth of less than 5 feet; hazard of leachate flow into ground water.
Severe: high susceptibility to frost action.	Severe: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet.	Moderate: moderate permeability; moderate hazard of effluent seepage.	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet.
Severe: low strength; high susceptibility to frost action.	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet.	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet.	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet.
Moderate: somewhat poorly drained.	Severe: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet.	Severe: rapidly permeable sand and gravel at a depth of less than 5 feet; severe hazard of effluent seepage.	Severe: rapidly permeable sand and gravel at a depth of less than 5 feet; free leachate flow into ground water.
Slight	Slight: possible pollution of nearby shallow wells.	Severe: very rapid permeability; severe hazard of effluent seepage.	Severe: very rapid permeability; hazard of leachate flow into ground water.
Severe: very poorly drained; high susceptibility to frost action.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot or ponded.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot or ponded.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot or ponded.
Slight	Slight	Severe: rapid permeability; severe hazard of effluent seepage.	Severe: rapid permeability; hazard of leachate flow into ground water; sand; poor compaction characteristics.
Moderate: slope	Moderate: slope	Severe: rapid permeability; severe hazard of effluent seepage.	Severe: rapid permeability; hazard of leachate flow into ground water; sand; poor compaction characteristics.
Slight: rapid permeability in substratum; cuts and fills generally needed.	Slight: possible pollution of nearby shallow wells.	Severe: moderate permeability; severe hazard of effluent seepage.	Severe: moderate permeability; hazard of leachate flow into ground water.
Severe: high susceptibility to frost action.	Severe: somewhat poorly drained; moderately slow permeability; seasonal high water table at a depth of 1 to 3 feet.	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet.	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; clay loam and loam.
Severe: high susceptibility to frost action; moderate shrink-swell potential.	Severe: slow permeability; somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet.	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet.	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; silty clay loam.
Severe: very poorly drained; high organic-matter content; very unstable.	Severe: very poorly drained; seasonal high water table at the surface or ponded.	Severe: very poorly drained; very high organic-matter content; seasonal high water table at the surface or ponded.	Severe: very high organic-matter content; cannot provide satisfactory cover; very poorly drained; seasonal high water table at the surface or ponded.

TABLE 8.—*Degree and kind of limitations of the*

Soil series and map symbols	Building sites			
	Dwellings		Commercial or light industrial development	Landscaping and lawns
	With basements	Without basements		
Elston: EsA	Slight	Slight	Slight	Slight
Fox: FsA, FsB	Slight	Slight	Slight	Slight
Gilford: Gf	Severe: very poorly drained.	Severe: very poorly drained.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot; subject to ponding.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot; subject to ponding.
Hillsdale:				
HdA	Slight	Slight	Slight	Slight
HdB	Slight	Slight	Slight	Slight
HeC2	Moderate: slope	Moderate: slope	Moderate: slope	Slight
HeD2	Severe: slope	Severe: slope	Severe: slope	Moderate: slope
Houghton: Hm, Ho	Severe: very poorly drained; organic material.	Severe: very poorly drained; organic material.	Severe: very poorly drained; organic material; seasonal high water table at a depth of 0 to 1 foot or ponded.	Severe: very poorly drained; very high organic-matter content; very unstable; seasonal high water table at a depth of 0 to 1 foot or ponded.
Landes: La	Severe: subject to frequent flooding.	Severe: subject to frequent flooding.	Severe: subject to frequent flooding.	Severe: subject to frequent flooding.
Martinsville:				
MeA	Slight	Slight	Slight	Slight
MeB2	Slight	Slight	Moderate: slope	Slight
MeC2	Moderate: slope	Moderate: slope	Severe: slope	Moderate: slope
Maumee:				
Mf	Severe: very poorly drained.	Severe: very poorly drained.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot or ponded.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot or ponded.

soils for town and country development—Continued

Building sites—Continued	Waste disposal systems		
Roads, streets, and parking lots	Septic tank absorption fields	Sewage lagoons	Sanitary landfill [1] (trench type)
Slight	Slight: possible pollution of nearby shallow wells.	Severe: rapidly permeable sand and gravel at a depth of less than 5 feet; severe hazard of effluent seepage.	Severe: rapidly permeable sand and gravel at a depth of less than 5 feet; hazard of leachate flow into ground water.
Slight	Slight: possible pollution of nearby shallow wells.	Severe: rapidly permeable sand and gravel at a depth of less than 5 feet; severe hazard of effluent seepage.	Severe: rapidly permeable sand and gravel at a depth of less than 5 feet; hazard of leachate flow into ground water.
Severe: very poorly drained; seasonal high water table.	Severe: very poorly drained; seasonal high water table; subject to ponding.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot or ponded; moderately rapid permeability; severe hazard of effluent seepage.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot or ponded; moderately rapid permeability; hazard of leachate flow into ground water.
	Slight	Moderate: moderate permeability.	Slight.
	Slight	Moderate: slope hinders construction; moderate hazard of effluent seepage; moderate permeability.	Slight.
Moderate: slope	Moderate: moderate hazard of effluent seepage at base of slopes.	Severe: slope hinders construction.	Slight.
Severe: slope	Severe: severe hazard of effluent seepage at base of slopes.	Severe: slope hinders construction.	Moderate: slope hinders construction.
Severe: very poorly drained; very high organic-matter content; very unstable.	Severe: very poorly drained; seasonal high water table at the surface or ponded.	Severe: very poorly drained; seasonal high water table at the surface or ponded; very high organic-matter content; promotes undesirable aquatic growth.	Severe: very poorly drained; seasonal high water table at the surface or ponded; too much organic matter to provide satisfactory cover.
Severe: subject to frequent flooding.	Severe: subject to frequent flooding.	Severe: subject to frequent flooding.	Severe: subject to frequent flooding.
Moderate: moderate susceptibility to frost action.	Slight: possible pollution of nearby shallow wells.	Severe: rapidly permeable, stratified sand at a depth of less than 5 feet; severe hazard of effluent seepage.	Severe: rapidly permeable, stratified sand at a depth of less than 5 feet; hazard of leachate flow into ground water.
Moderate: moderate susceptibility to frost action.	Slight: possible pollution of nearby shallow wells.	Severe: rapidly permeable, stratified sand at a depth of less than 5 feet; severe hazard of effluent seepage.	Severe: rapidly permeable, stratified sand at a depth of less than 5 feet; hazard of leachate flow into ground water.
Moderate: moderate susceptibility to frost action.	Moderate: possible pollution of nearby shallow wells.	Severe: rapidly permeable, stratified sand at a depth of less than 5 feet; severe hazard of effluent seepage.	Severe: rapidly permeable, stratified sand at a depth of less than 5 feet; hazard of leachate flow into ground water.
Severe: very poorly drained; subject to ponding.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot or ponded.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot or ponded; very rapid permeability; severe hazard of effluent seepage; high organic-matter content; promotes undesirable aquatic growth.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot or ponded; very rapid permeability; hazard of leachate flow into ground water; sand; poor composition characteristics; allows release of odors and insect infestation.

TABLE 8.—*Degree and kind of limitations of the*

Soil series and map symbols	Building sites			
	Dwellings		Commercial or light industrial development	Landscaping and lawns
	With basements	Without basements		
Mg	Severe: very poorly drained.	Severe: very poorly drained.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot or ponded.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot or ponded.
Metea: MkB	Slight	Slight	Slight	Moderate: droughty
Miami:				
MmB	Slight	Slight	Moderate: slope	Slight
MmC2	Moderate: slope	Moderate: slope	Severe: slope	Moderate: slope
MoC3	Moderate: slope	Moderate: slope	Severe: slope	Moderate: slope, too clayey.
MoD3	Severe: moderate permeability; slope.	Severe: slope	Severe: slope; earth moving generally required.	Severe: slope
Milford: Mp	Severe: poorly drained.	Severe: poorly drained.	Severe: poorly drained; subject to ponding; seasonal high water table at a depth of 0 to 1 foot.	Moderate: poorly drained; seasonal high water table at a depth of 0 to 1 foot.
Morley:				
MrB2	Moderate: moderate shrink-swell potential; clayey material.	Moderate: moderate shrink-swell potential; clayey material.	Moderate: moderate shrink-swell potential; clayey material, slope.	Slight
MrC2	Moderate: slope; moderate shrink-swell potential; clayey material.	Moderate: slope; moderate shrink-swell potential; clayey material.	Severe: slope	Moderate: slope
MsD3	Severe: slope	Severe: slope	Severe: slope	Severe: slope
Oshtemo:				
OsA	Slight	Slight	Slight	Slight
OsB	Slight	Slight	Moderate: slope	Slight

soils for town and country development—Continued

Building sites—Continued	Waste disposal systems		
Roads, streets, and parking lots	Septic tank absorption fields	Sewage lagoons	Sanitary landfill [1] (trench type)
Severe: very poorly drained; subject to ponding; susceptible to frost action.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot or ponded.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot or ponded; rapid permeability; severe hazard of effluent seepage; high organic-matter content; promotes undesirable aquatic growth.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot or ponded; rapid permeability; hazard of leachate flow into ground water; sand; poor composition characteristics; allows release of odors and insect infestation.
Moderate: moderate shrink-swell potential; fair to good stability; moderate susceptibility to frost action.	Moderate: lower end of moderate permeability.	Moderate: slope hinders construction; moderate permeability; moderate hazard of effluent seepage.	Slight.
Moderate: moderate shrink-swell potential; fair to poor shear strength and compaction characteristics; susceptible to frost action.	Moderate: lower end of moderate permeability; moderate hazard of effluent seepage at base of slopes.	Moderate: slope hinders construction; moderate permeability; moderate hazard of effluent seepage.	Slight.
Moderate: moderate shrink-swell potential; fair to poor shear strength and compaction characteristics; susceptible to frost action.	Moderate: lower end of moderate permeability; moderate hazard of effluent seepage at base of slopes.	Severe: slope hinders construction.	Slight.
Moderate: moderate shrink-swell potential; fair to poor shear strength and compaction characteristics; susceptible to frost action.	Moderate: lower end of moderate permeability; moderate hazard of effluent seepage at base of slopes.	Severe: slope hinders construction.	Slight.
Severe: slope	Severe: slope; hazard of effluent seepage at base of slopes.	Severe: slope hinders construction.	Moderate: slope hinders construction.
Severe: high shrink-swell potential; fair to poor shear strength and compaction characteristics; fair stability; high water table; high compressibility.	Severe: moderately slow permeability; poorly drained; seasonal high water table at a depth of 0 to 1 foot.	Severe: poorly drained; seasonal high water table.	Severe: poorly drained; seasonal high water table at a depth of 0 to 1 foot; silty clay limits workability.
Moderate: moderate shrink-swell potential; susceptible to frost action.	Severe: slow permeability	Moderate: slope hinders construction.	Moderate: silty clay loam limits workability.
Moderate: moderate shrink-swell potential; susceptible to frost action.	Severe: slow permeability	Severe: slope hinders construction.	Moderate: silty clay loam limits workability.
Severe: slope	Severe: slow permeability	Severe: slope hinders construction.	Moderate: silty clay loam limits workability.
Slight	Slight: possible pollution of nearby shallow wells.	Severe: moderately rapid permeability; severe hazard of effluent seepage.	Severe: moderately rapid permeability; hazard of leachate flow into ground water.
Slight	Slight: possible pollution of nearby shallow wells.	Severe: moderately rapid permeability; severe hazard of effluent seepage.	Severe: moderately rapid permeability; hazard of leachate flow into ground water.

TABLE 8.—*Degree and kind of limitations of the*

Soil series and map symbols	Building sites			
	Dwellings		Commercial or light industrial development	Landscaping and lawns
	With basements	Without basements		
OsC2	Moderate: slope	Moderate: slope	Severe: slope	Moderate: slope
OsD	Severe: slope	Severe: slope	Severe: slope	Moderate: slope
Palms: Pa	Severe: very poorly drained; organic material.	Severe: very poorly drained; organic material.	Severe: very poorly drained; organic material; seasonal high water table at the surface or ponded.	Severe: very poorly drained; organic material; seasonal high water table at the surface or ponded.
Quinn: Qu	Severe: poorly drained.	Severe: poorly drained.	Severe: poorly drained; seasonal high water table at a depth of 0 to 1 foot.	Moderate: poorly drained; seasonal high water table at a depth of 0 to 1 foot.
Rensselaer: Re, Rm	Severe: very poorly drained.	Severe: very poorly drained.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot or ponded.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot or ponded.
Riddles:				
RtA	Slight	Slight	Slight	Slight
RtB	Slight	Slight	Moderate: slope	Slight
RtC2	Moderate: slope	Moderate: slope	Severe: slope; subject to erosion; earth moving generally required.	Moderate: slope
RtD2	Severe: slope	Severe: slope	Severe: slope; subject to erosion; earth moving generally required.	Severe: slope
Tedrow: Te	Severe: somewhat poorly drained.	Severe: somewhat poorly drained.	Severe: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet.	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet.
Tracy:				
TrA	Slight	Slight	Slight	Slight
TrB	Slight	Slight	Moderate: slope	Slight

soils for town and country development—Continued

Building sites—Continued	Waste disposal systems		
Roads, streets, and parking lots	Septic tank absorption fields	Sewage lagoons	Sanitary landfill [1] (trench type)
Moderate: slope	Moderate: slope; moderate hazard of effluent seepage at base of slopes; possible pollution of nearby shallow wells.	Severe: slope; moderately rapid permeability; severe hazard of effluent seepage.	Severe: moderately rapid permeability; hazard of leachate flow into ground water.
Severe: slope	Severe: slope; severe hazard of effluent seepage at base of slopes.	Severe: slope; moderately rapid permeability; severe hazard of effluent seepage.	Severe: moderately rapid permeability; hazard of leachate flow into ground water.
Severe: organic material; high water table.	Severe: very poorly drained; seasonal high water table at the surface or ponded.	Severe: very poorly drained; seasonal high water table at the surface or ponded; very high organic-matter content; promotes undesirable aquatic growth.	Severe: very poorly drained; seasonal high water table at the surface or ponded; too much organic matter to provide satisfactory cover.
Severe: poorly drained; seasonal high water table; susceptible to frost action.	Severe: poorly drained; seasonal high water table at a depth of 0 to 1 foot.	Severe: poorly drained; seasonal high water table at a depth of 0 to 1 foot; severe hazard of effluent seepage.	Severe: poorly drained; seasonal high water table at a depth of 0 to 1 foot; hazard of leachate flow into ground water.
Severe: very poorly drained; seasonal high water table; susceptible to frost action.	Severe: slow permeability; very poorly drained; seasonal high water table at a depth of 0 to 1 foot or ponded.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot or ponded; rapidly permeable, stratified sand at a depth of less than 5 feet; severe hazard of effluent seepage.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot or ponded; rapidly permeable, stratified sand at a depth of less than 5 feet; hazard of leachate flow into ground water.
Moderate: moderate shrink-swell potential; moderate susceptibility to frost action.	Moderate: lower end of moderate permeability; moderate hazard of effluent seepage at base of slopes.	Moderate: moderate permeability.	Slight.
Moderate: moderate shrink-swell potential; susceptible to frost action; side slopes of cuts subject to erosion.	Moderate: lower end of moderate permeability; moderate hazard of effluent seepage at base of slopes.	Moderate: slope hinders construction; moderate permeability; moderate hazard of effluent seepage.	Slight.
Moderate: moderate shrink-swell potential; susceptible to frost action; side slopes of cuts subject to erosion.	Moderate: lower end of moderate permeability; moderate hazard of effluent seepage at base of slopes.	Severe: slope	Slight.
Severe: slope	Severe: slope; severe hazard of effluent seepage at base of slopes.	Severe: slope	Slight.
Moderate: susceptible to frost action; somewhat poorly drained.	Severe: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet.	Severe: rapid permeability; severe hazard of effluent seepage.	Severe: rapid permeability; hazard of leachate flow into ground water; sand; poor compaction characteristics; allows release of odors and insect infestation.
Moderate: moderate susceptibility to frost action; low strength.	Slight: possible pollution of nearby shallow wells.	Severe: rapidly permeable, stratified loamy sand and sandy loam at a depth of less than 5 feet; severe hazard of effluent seepage.	Severe: rapidly permeable, stratified loamy sand and sandy loam at a depth of less than 5 feet; hazard of leachate flow into ground water.
Moderate: moderate susceptibility to frost action; low strength.	Slight: possible pollution of nearby shallow wells.	Severe: rapidly permeable, stratified loamy sand and sandy loam at a depth of less than 5 feet; severe hazard of effluent seepage.	Severe: rapidly permeable, stratified loamy sand and sandy loam at a depth of less than 5 feet; hazard of leachate flow into ground water.

TABLE 8.—*Degree and kind of limitations of the*

Soil series and map symbols	Building sites			
	Dwellings		Commercial or light industrial development	Landscaping and lawns
	With basements	Without basements		
TrC2	Moderate: slope	Moderate: slope	Severe: slope	Moderate: slope
Troxel: Tx	Slight	Slight	Slight	Slight
Tyner: TyA	Slight	Slight	Slight	Moderate: droughty
TyC	Moderate: slope	Moderate: slope	Severe: slope	Moderate: droughty, slope
TyD	Severe: slope	Severe: slope	Severe: slope	Severe: slope
Wallkill: Wk	Severe: very poorly drained; organic material.	Severe: very poorly drained; organic material.	Severe: very poorly drained; organic material; seasonal high water table at a depth of 0 to 1 foot or ponded.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot or ponded; mineral soils over organic soils unstable.
Washtenaw: Ws	Severe: seasonal high water table at a depth of 0 to 1 foot or ponded.	Severe: seasonal high water table at a depth of 0 to 1 foot or ponded.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot or ponded.	Severe: poorly drained; seasonal high water table at a depth of 0 to 1 foot or ponded.
Whitaker: Wt	Severe: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet.	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet.

[1] Onsite study is needed of the underlying strata, the water table, and the hazards of aquifer pollution and drainage into ground

The soils are evaluated only to a depth of 5 feet. The ratings used in table 8 are *slight*, *moderate*, and *severe*. *Slight* means that the soil has few limitations. *Moderate* means that the soil has limitations that can be overcome with good management and careful design. *Severe* means that the soil has limitations severe enough to make use questionable, and measures needed to overcome the limitations generally are not practical.

The columns in table 8 are explained in the paragraphs that follow.

Dwellings refers to single-family dwellings and other structures with similar foundation requirements. Excluded are buildings of more than three stories and other buildings with foundation loads in excess of those equal to three-story dwellings. Interpretations are for undisturbed soils. Considered in the ratings for dwellings with basements are the cost of excavation, the bearing strength of the foundation, and the drainage around the basement. Also considered are factors that influence the installation of utility lines, such as those between the dwellings and the trunk lines. Soil characteristics that affect construction of dwellings include drainage, seasonal high water table, hazard of flooding, slope, shrink-swell potential, texture, potential frost action, and depth to bedrock. Onsite investigations are needed for specific placement of buildings and utility lines and for detailed design of foundations.

Commercial or light industrial development refers to shopping centers and small industrial buildings with foundation requirements not exceeding those of ordinary three-story dwellings. Soil characteristics that affect industrial or commercial sites include drainage, depth to seasonal high water table, hazard of flooding, slope, shrink-swell potential, texture, potential frost action, and depth to bedrock. Onsite investigations are needed for specific placement of buildings and utility lines and for detailed design of foundations.

Building sites—Continued	Waste disposal systems		
Roads, streets, and parking lots	Septic tank absorption fields	Sewage lagoons	Sanitary landfill [1] (trench type)
Moderate: slope	Moderate: slope; moderate hazard of effluent seepage at base of slopes; possible pollution of nearby shallow wells.	Severe: rapidly permeable, stratified loamy sand and sandy loam at a depth of less than 5 feet; severe hazard of effluent seepage.	Severe: rapidly permeable, stratified loamy sand and sandy loam at a depth of less than 5 feet; hazard of leachate flow into ground water.
Severe: fair shear strength; slight compressibility; high susceptibility to frost action.	Slight: possible pollution of nearby shallow wells.	Severe: moderate permeability; severe hazard of effluent seepage.	Severe: moderate permeability; hazard of leachate flow into ground water.
Slight	Slight	Severe: rapid permeability; severe hazard of effluent seepage.	Severe: rapid permeability; hazard of leachate flow into ground water.
Moderate: slope	Moderate: slope; possible pollution of nearby shallow wells.	Severe: rapid permeability; severe hazard of effluent seepage.	Severe: rapid permeability; hazard of leachate flow into ground water.
Severe: slope	Severe: slope; possible pollution of nearby shallow wells.	Severe: rapid permeability; severe hazard of effluent seepage.	Severe: rapid permeability; hazard of leachate flow into ground water.
Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot or ponded.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot or ponded.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot or ponded; organic soil below a depth of 2 feet; promotes undesirable aquatic growth.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot or ponded; organic soil below a depth of 2 feet; too much organic matter to provide satisfactory cover.
Severe: very poorly drained; seasonal high water table; fair to good stability and compaction characteristics; fair shear strength; susceptible to frost action.	Severe: slow permeability; very poorly drained; seasonal high water table at a depth of 0 to 1 foot or ponded.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot or ponded.	Severe: very poorly drained; seasonal high water table at a depth of 0 to 1 foot or ponded.
Severe: high susceptibility to frost action.	Severe: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet.	Severe: rapidly permeable, stratified sand at a depth of less than 5 feet; severe hazard of effluent seepage.	Severe: rapidly permeable, stratified sand at a depth of less than 5 feet; hazard of leachate flow into ground water.

[1] water for landfills deeper than 5 or 6 feet.

Landscaping and lawns are important in both residential and commercial areas. Soil characteristics that affect the establishment and maintenance of lawns and shrubs are slope, drainage, depth to seasonal high water table, hazard of flooding and ponding, available water capacity, texture of the surface layer, hazard of erosion, and depth to which roots can penetrate.

Local roads, streets, and parking lots are expected to carry automobile traffic all year. They consist of underlying soil material, either cut or fill, called the road subgrade; the base material of gravel, crushed rock, or lime or soil stabilized with cement, called the surface; and the pavement, usually asphalt or concrete. It is assumed that the subgrade consists mainly of the soil at hand and that cuts and fills are generally less than 6 feet. Soil characteristics that affect construction include drainage, hazard of flooding, slope, depth to bedrock, texture, shrink-swell potential, and susceptibility to frost action.

A septic tank system generally consists of a septic tank for holding solid wastes, a distribution box for dispensing effluent, and a tile disposal field. The system depends on the ability of the soil to absorb and filter the liquid effluent passed through the tile. Soil characteristics that affect absorption include permeability, depth to seasonal high water table, hazard of flooding, slope, and depth to bedrock or other impervious material.

Sewage lagoons are shallow ponds used to hold sewage long enough for bacteria to decompose the solids. The lagoon must be able to hold water with minimum seepage to prevent contamination of water supplies. Soil characteristics that affect sewage lagoons are depth to seasonal high water table, permeability, depth to bedrock, slope, coarse fragments, organic matter, hazard of flooding, and texture.

Sanitary landfill refers to the trench type of landfill with a cover of material at hand. A sanitary landfill

should not contaminate water supplies, reduce the esthetic value of the land, or cause health hazards, and it should be usable throughout the year. Soil characteristics that affect the establishment and operation of a sanitary landfill include depth to seasonal high water table, drainage, hazard of flooding, permeability, slope, texture, and depth to bedrock. The ratings in table 8 apply only to a depth of about 5 feet. Because many trenches are 15 feet deep or more, a geologic investigation of the area should be made to determine the potential pollution to ground water and to design the landfill. This soil survey can help in selecting potential sites and in determining where additional investigations are warranted.

Trees and Shrubs for Environmental Improvement [4]

Trees and shrubs benefit the community in many ways besides growing wood crops. They have lasting value for—

1. Wind protection: Scattered trees and wooded tracts tend to break up the regular wind pattern and reduce velocity.
2. Wildlife: Islands of woody cover are essential habitat for songbirds and many other animals.
3. Erosion reduction: Trees are an excellent erosion control crop and can serve as a filter strip for streams and reservoirs.
4. Recreation and education: Wooded tracts provide sites for county parks, outdoor laboratories for schools, and nature areas.
5. Air pollution: Trees cool and purify the air by releasing moisture and oxygen into the atmosphere.
6. Beautification: Wooded tracts add scenic beauty to the land and help create a healthful and pleasing environment.

In table 9, the soils in St. Joseph County have been placed in five tree and shrub groups to help land users plan environmental improvements. Group identification numbers are generally assigned locally but are part of a statewide system. Because all the groups in the system are not represented in St. Joseph County, the group numbers in this soil survey are not consecutive. The tree and shrub group for each soil is listed in the "Guide to Mapping Units" at the back of this survey.

Table 9 lists some trees and shrubs suitable for environmental improvement projects for each of the five groups. Some of the plants grow naturally, and the others can be planted. For assistance and more information about suitable trees and shrubs, contact local landscape architects, commercial nurseries, or foresters.

[4] MITCHELL G. HASSLER, woodland conservationist, Soil Conservation Service, helped prepare this section.

TABLE 9.—*Suitability of the soils for trees and shrubs for environmental improvement*

[Alluvial land (Am), Gravel pits (GP), Made land (Ma), and Marsh (Mc) are not listed in this table because their properties are too variable for interpretations to be made]

Tree and shrub groups and soil series	Trees and shrubs suitable for—			
	Home and park sites	Windbreaks, screens, and sound barriers	Beauty and shade	Attracting songbirds and wildlife
Group 1. Very poorly drained and poorly drained, depressional and nearly level, mineral and organic soils that have a seasonal high water table within 1 foot of the surface or are ponded. Adrian, Brookston, Edwards, Houghton, Milford, Palms, Quinn, Wallkill, Washtenaw.	Pin oak, bur oak, red maple, sweetgum, white ash, tulip-poplar, hickory, river birch.	American arborvitae, lombardy poplar, gray dogwood, redosier dogwood, silky dogwood, amur honeysuckle, arctic willow, medium purple willow, tall purple willow.	American arborvitae, European larch, black sourgum, red sweetgum, river birch, pin oak, red maple, lombardy poplar, weeping willow, black spruce.	American arborvitae, black sourgum, pin oak, red maple, black spruce, gray dogwood, redosier dogwood, elderberry, amur honeysuckle, buttonbush, trumpetcreeper.
Group 2. Somewhat poorly drained, nearly level and gently sloping soils that have a seasonal high water table at a depth of 1 to 3 feet. Alida, Aubbeenaubbee, Blount, Brady, Crosier, Del Rey, Tedrow, Whitaker.	Sweetgum, pin oak, soft maple, white ash, tulip-poplar, bur oak, black oak, chestnut oak, sugar maple, hickory, blackgum, beech.	White pine, Norway spruce, white spruce, tulip-poplar, pin oak, basswood, autumn-olive, amur honeysuckle, highbush cranberry, blackhaw, shadblow serviceberry, cutleaf sumac, arrowwood, cornelian cherry dogwood, rose-of-Sharon.	White pine, white spruce, baldcypress, basswood, cornelian cherry dogwood, cutleaf sumac.	White pine, Norway spruce, white spruce, tulip-poplar, pin oak, basswood, autumn-olive, amur honeysuckle, highbush cranberry, spicebush, blackhaw, arrowwood, cornelian cherry dogwood, cut leaf sumac, trumpetcreeper, ground euonymus.

TABLE 9.—*Suitability of the soils for trees and shrubs for environmental improvement*—Continued

Tree and shrub groups and soil series	Trees and shrubs suitable for—			
	Home and park sites	Windbreaks, screens, and sound barriers	Beauty and shade	Attracting songbirds and wildlife
Group 3. Well drained and moderately well drained, nearly level and strongly sloping soils that have a water table below a depth of 6 feet. Hillsdale, Landes, Martinsville, Miami, Morley, Riddles.	Upland oaks, tulip-poplar, sweetgum, sugar maple, black walnut, beech, hickory, white ash, blackgum, red elm.	White pine, red pine, Norway spruce, Canadian hemlock, blackgum, honeylocust (thornless), autumn-olive, amur honeysuckle, highbush cranberry, blackhaw, shadblow serviceberry, spindle tree, French lilac, mockorange.	White pine, red pine, Norway spruce, Canadian hemlock, black locust, tulip-poplar, blackgum, honeylocust, mountain ash, Norway maple, ginkgo, white birch, flowering dogwood, linden basswood (Judas-tree), redbud, cornelian cherry dogwood, flowering crabapples, Washington hawthorn.	Canadian hemlock, black locust, mountain ash, Norway maple, white birch, flowering dogwood, linden basswood (Judas-tree), redbud, autumn-olive, amur honeysuckle, highbush cranberry, blackhaw, maple leaf viburnum, shadblow serviceberry, cornelian cherry dogwood, winged burningbush, flowering crabapples, Washington hawthorn, mockorange, coralberry.
Group 5. Poorly drained and very poorly drained, depressional and nearly level soils that have a seasonal high water table within 1 foot of the surface. Gilford, Maumee, Rensselaer.	Pin oak, white pine, aspen, white oak, red maple, black oak.	Pin oak, white pine, gray dogwood, redosier dogwood, silky dogwood, arctic willow, medium purple willow, tall purple willow, red pine.	Pin oak, red maple, white pine, European larch, black spruce, red pine.	Pin oak, white pine, gray dogwood, redosier dogwood, silky dogwood, winterberry, black cranberry.
Group 6. Moderately well drained, well drained, and excessively drained, nearly level and strongly sloping soils that have a water table below a depth of 6 feet. Brems, Chelsea, Coupee, Elston, Fox, Metea, Oshtemo, Tracy, Troxel, Tyner.	Upland oaks, tulip-poplar, red pine, white pine, jack pine, white ash, hickory, black walnut, sugar maple, blackgum.	Red pine, white pine, jack pine, Austrian pine, forsythia, hazelnut, lilac, tamarisk, privet, autumn-olive.	Red pine, white pine, jack pine, Austrian pine, black locust, scarlet oak, blackgum, flowering dogwood.	Black locust, scarlet oak, blackgum, forsythia, hazelnut, regels privet. Jersey-tea, Japanese barberry, autumn-olive, flowering dogwood.

Recreation

St. Joseph County has many recreation facilities, including Bendix Woods County Park, Elbel Park, Erskine Park, George Wilson Park, Merrifield Park, Pinhook Park, Potawatomi Park, Rum Village Park, and other parks along the St. Joseph River (fig. 15). Watershed development in the county creates reservoirs that can be used for boating, fishing, swimming, and other waterbased recreation. Other areas are well suited for campsites, picnic areas, playgrounds, paths and trails, and golf course fairways.

In table 10, the soils in St. Joseph County are rated according to their suitability for developing recreation facilities. A rating of *slight* means that the facility is easily created, improved, or maintained, and few or no limitations affect design or management. *Moderate* means that the facility can be created, improved, or maintained, but moderate soil limitations affect design and management. *Severe* means that extreme measures are needed to overcome soil limitations, and creating the facility is generally not practical.

In some circumstances soil limitations can be modified or removed so that the soil can be used safely. Not considered in the ratings are location, land value, esthetic value, and population density. For information about the suitability of the soils for cottage foundations and cottage sites, see the ratings for dwellings in the section "Use of Soils for Town and Country Planning."

Following are explanations of the columns in table 10.

Campsites are used for tents and camp trailers. The soils should be suitable for unsurfaced parking, for heavy foot traffic, and for limited vehicular traffic. It is assumed that little site preparation will be done other than shaping and leveling for tent and parking areas. Soil characteristics considered are wetness and the hazard of flooding, permeability, slope, texture of the surface layer, coarse fragments, and stoniness or rockiness. Soil suitability for vegetation was not considered in these ratings but should be considered in the final evaluation of the site.

Picnic areas are subject to heavy foot traffic, but it is assumed that most vehicular traffic will be confined to access roads. Soil characteristics considered are wetness and the hazard of flooding, slope, texture of the surface layer, coarse fragments on the surface, and stoniness or rockiness. Not considered in the ratings are such features as trees or ponds, which may affect the desirability of a site, or soil suitability for vegetation.

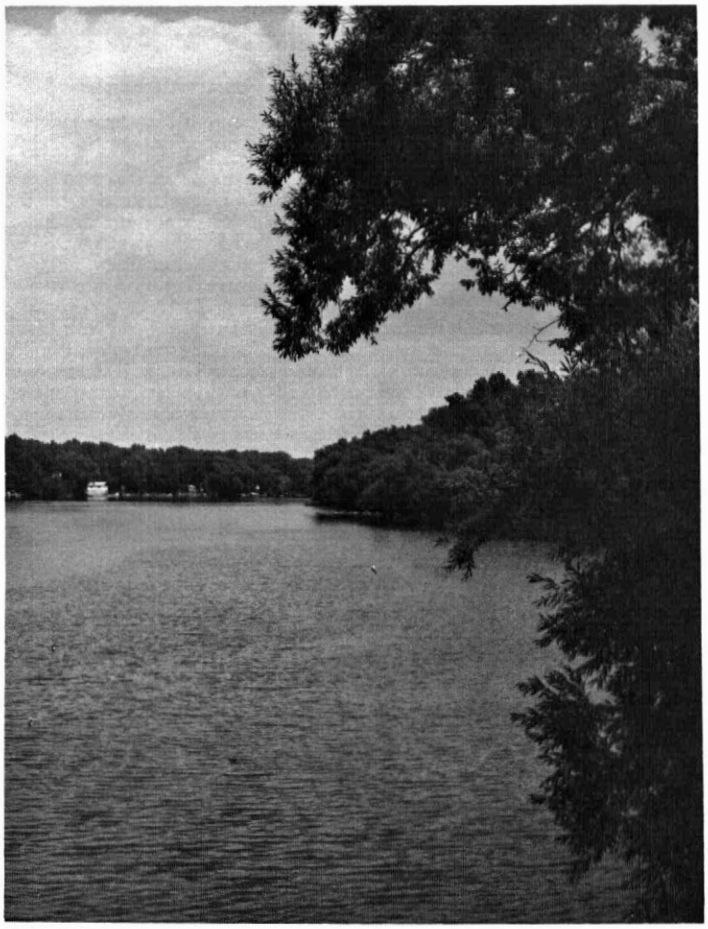

Figure 15.—**The St. Joseph River is a recreation area for the county.**

Playgrounds are used for baseball, football, tennis, badminton, and other similar organized games. These areas are subject to intensive foot traffic and generally require a firm, level surface and good drainage. Soil characteristics considered are wetness and the hazard of flooding, permeability, slope, texture and consistence of the surface layer, depth to bedrock, coarse fragments, and stoniness or rockiness. Soil suitability for vegetation was not considered in these ratings.

Paths and trails are local and cross-county foot paths and trails and bridle paths. It is assumed that these are natural areas with few or no cuts or fills. Considered in the ratings are soil features that affect trafficability, dustiness, and design and maintenance of the trafficways. These are wetness and the hazard of flooding, slope, texture of the surface layer, coarse fragments on the surface, and rockiness or stoniness. Many soils that have severe limitations for paths and trails are the most interesting from an esthetic and naturalist viewpoint. A rating of severe indicates a path or trail will be costly to build and maintain, but it should not preclude construction.

In evaluating the soils for golf courses, only those soil features that affect fairways were considered. Greens, traps, and hazards are manmade, generally from transported soil material. Soil used for fairways should be well drained and firm, be free of flooding during the period of use, have good trafficability, contain a minimum of coarse fragments or stones, and have gently undulating slopes. They should be capable of supporting a good turf and be well suited to many kinds of trees and shrubs. Loamy soils are best, but coarser textured soils are well suited if they are irrigated. Poorly drained mineral soils have severe limitations, but they may be used for pond sites to provide esthetic value or to store water for maintaining

TABLE 10.—*Degree and kind of limitations of the soils for recreation facilities*

[Alluvial land (Am), Gravel pits (GP), Made land (Ma), and Marsh (Mc) are not listed in the table because their properties are too variable for reliable interpretations to be made]

Soil series and map symbols	Camp sites	Picnic areas	Playgrounds	Paths and trails	Golf course fairways
Adrian: Ad	Severe: very poorly drained; organic material; subject to ponding.	Severe: very poorly drained; organic material; subject to ponding.	Severe: very poorly drained; organic material; subject to ponding.	Severe: very poorly drained; high water table; subject to ponding.	Severe: very poorly drained; high water table; subject to ponding.
Alida: AeA	Moderate: somewhat poorly drained; compacts easily; remains wet and soft for short periods.	Moderate: somewhat poorly drained; compacts easily and is sticky when wet.	Moderate: somewhat poorly drained; compact and sticky when wet; slow to dry after rain.	Moderate: somewhat poorly drained; wet for short periods; muddy and slippery when wet.	Moderate: somewhat poorly drained; compacts easily when wet; turf easily damaged.
Aubbeenaubbee: Au	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.
Blount: BbA	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained; slow permeability.	Moderate: somewhat poorly drained; seasonal high water table.	Moderate: somewhat poorly drained; seasonal high water table.
Brady: Bd	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.

TABLE 10.—*Degree and kind of limitations of the soils for recreation facilities*—Continued

Soil series and map symbols	Camp sites	Picnic areas	Playgrounds	Paths and trails	Golf course fairways
Brems: BeA	Moderate: loamy sand surface layer; unstable; subject to blowing.	Moderate: loamy sand surface layer; unstable; subject to blowing.	Moderate: loamy sand surface layer; unstable; subject to blowing.	Moderate: loamy sand surface layer; unstable; poor footing and trafficability.	Moderate: loamy sand surface layer; unstable; subject to blowing.
Brookston: Br	Severe: very poorly drained; subject to ponding.	Severe: very poorly drained; subject to ponding.	Severe: very poorly drained; subject to ponding.	Severe: very poorly drained; high water table.	Severe: very poorly drained; high water table.
Chelsea:					
ChA	Moderate: fine sand surface layer; droughty; subject to blowing.	Moderate: fine sand surface layer; droughty; subject to blowing.	Severe: fine sand surface layer; droughty; subject to blowing.	Severe: fine sand surface layer; subject to blowing; poor footing.	Severe: fine sand surface layer; droughty.
ChC	Moderate: fine sand surface layer; very droughty; subject to blowing.	Moderate: fine sand surface layer; very droughty; subject to blowing.	Severe: fine sand surface layer; very droughty; subject to blowing; slope.	Severe: fine sand surface layer; very poor footing; subject to blowing.	Severe: fine sand surface layer; very droughty.
Coupee: CoA	Slight	Slight	Slight	Slight	Slight.
Crosier: CtA, CtB	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained; moderately slow permeability.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.
Del Rey: De	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.	Moderate: somewhat poorly drained.
Edwards: Ed	Severe: very poorly drained; organic material; subject to ponding.	Severe: very poorly drained; organic material; subject to ponding.	Severe: very poorly drained; organic material; subject to ponding.	Severe: very poorly drained; organic material; subject to ponding.	Severe: very poorly drained; organic material; subject to ponding.
Elston: EsA	Slight	Slight	Slight	Slight	Slight.
Fox:					
FsA	Slight	Slight	Slight	Slight	Slight.
FsB	Slight	Slight	Moderate: slope	Slight	Slight.
Gilford: Gf	Severe: wet	Severe: wet	Severe: wet	Severe: wet	Severe: wet.
Hillsdale:					
HdA	Slight	Slight	Slight	Slight	Slight.
HdB	Slight	Slight	Moderate: slope	Slight	Slight.
HeC2	Moderate: slope	Moderate: slope	Severe: slope	Slight	Moderate: slope.
HeD2	Severe: slope	Severe: slope	Severe: slope	Moderate: slope	Severe: slope.
Houghton: Hm, Ho	Severe: very poorly drained; organic material; subject to ponding.	Severe: very poorly drained; organic material; subject to ponding.	Severe: very poorly drained; organic material; subject to ponding.	Severe: very poorly drained; organic material; subject to ponding.	Severe: very poorly drained; organic material; subject to ponding.
Landes: La	Severe: subject to flooding.	Moderate: subject to flooding.	Severe: subject to flooding.	Moderate: subject to flooding.	Moderate: subject to flooding.
Martinsville:					
MeA	Slight	Slight	Slight	Slight	Slight.
MeB2	Slight	Slight	Moderate: slope	Slight	Slight.
MeC2	Moderate: slope	Moderate: slope	Severe: slope	Slight	Moderate: slope.
Maumee: Mf, Mg	Severe: wet	Severe: wet	Severe: wet	Severe: wet	Severe: wet.
Metea: MkB	Moderate: too sandy.	Moderate: too sandy.	Moderate: slope, too sandy.	Moderate: too sandy.	Moderate: too sandy.
Miami:					
MmB	Slight	Slight	Moderate: slope	Slight	Slight.
MmC2	Moderate: slope	Moderate: slope	Severe: slope	Slight	Moderate: slope.
MoC3	Moderate: slope; too clayey.	Moderate: slope; too clayey.	Severe: slope	Moderate: too clayey.	Moderate: too clayey.
MoD3	Severe: slope; severely eroded.	Severe: slope	Severe: slope	Moderate: slope; too clayey.	Severe: slope.

TABLE 10.—*Degree and kind of limitations of the soils for recreation facilities*—Continued

Soil series and map symbols	Camp sites	Picnic areas	Playgrounds	Paths and trails	Golf course fairways
Milford: Mp	Severe: wet	Severe: wet	Severe: wet	Severe: wet	Severe: wet.
Morley:					
MrB2	Slight	Slight	Moderate: slope	Slight	Slight.
MrC2	Moderate: slope	Moderate: slope	Severe: slope	Slight	Slight.
MsD3	Severe: slope	Severe: slope	Severe: slope	Moderate: slope; too clayey.	Severe: slope.
Oshtemo:					
OsA	Slight	Slight	Slight	Slight	Slight.
OsB	Slight	Slight	Moderate: slope	Slight	Slight.
OsC2	Moderate: slope	Moderate: slope	Severe: slope	Slight	Moderate: slope.
OsD	Severe: slope	Severe: slope	Severe: slope	Moderate: slope	Severe: slope.
Palms: Pa	Severe: very poorly drained; organic material; subject to ponding.	Severe: very poorly drained; organic material; subject to ponding.	Severe: very poorly drained; organic material; subject to ponding.	Severe: very poorly drained; organic material; subject to ponding.	Severe: very poorly drained; organic material; subject to ponding.
Quinn: Qu	Severe: poorly drained.	Severe: poorly drained.	Severe: poorly drained.	Severe: poorly drained.	Severe: poorly drained.
Rensselaer: Re, Rm	Severe: wet	Severe: wet	Severe: wet	Severe: wet	Severe: wet.
Riddles:					
RtA	Slight	Slight	Slight	Slight	Slight.
RtB	Slight	Slight	Moderate: slope	Slight	Slight.
RtC2	Moderate: slope	Moderate: slope	Severe: slope	Slight	Moderate: slope.
RtD2	Severe: slope	Severe: slope	Severe: slope	Moderate: slope	Severe: slope.
Tedrow: Te	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; loamy sand surface layer tends to impede trafficability and is droughty in mid and late summer.	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; loamy sand surface layer tends to impede trafficability and is droughty in mid and late summer.	Moderate: somewhat poorly drained; seasonal high water table at a depth of 1 to 3 feet; loamy sand surface layer tends to impede trafficability and is droughty in mid and late summer.	Moderate: somewhat poorly drained; loamy sand surface layer tends to impede trafficability.	Moderate: somewhat poorly drained; loamy sand surface layer is droughty in mid and late summer.
Tracy:					
TrA	Slight	Slight	Slight	Slight	Slight.
TrB	Slight	Slight	Moderate: slope	Slight	Slight.
TrC2	Moderate: slope	Moderate: slope	Severe: slope	Slight	Moderate: slope.
Troxel: Tx	Moderate: subject to occasional ponding during periods of heavy rain.	Moderate: subject to occasional ponding during periods of heavy rain.	Moderate: subject to occasional ponding during periods of heavy rain.	Moderate: subject to occasional ponding during periods of heavy rain.	Slight.
Tyner:					
TyA	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.
TyC	Moderate: too sandy; slope.	Moderate: too sandy; slope.	Severe: slope	Moderate: too sandy; slope.	Moderate: too sandy.
TyD	Severe: slope	Severe: slope	Severe: slope	Moderate: too sandy; slope.	Severe: slope.
Wallkill: Wk	Severe: very poorly drained; organic material; subject to ponding.	Severe: very poorly drained; organic material; subject to ponding.	Moderate: very poorly drained; organic material; subject to ponding.	Moderate: very poorly drained; organic material; subject to ponding.	Moderate: very poorly drained; organic material; subject to ponding.
Washtenaw: Ws	Severe: wet	Severe: wet	Severe: wet	Severe: wet	Severe: wet.
Whitaker: Wt	Moderate: wet	Moderate: wet	Moderate: wet	Moderate: wet	Moderate: wet.

the turf. Sandy soils may be used as hazards or as a source of sand for greens. Soil characteristics considered in the ratings are depth to seasonal high water table, drainage, stoniness or rockiness of the surface, hazard of flooding, texture of the surface layer, and slope.

Formation and Classification of the Soils

In this section the factors that have affected the formation of soils in St. Joseph County are discussed. The current system of soil classification is explained, and the soil series are classified by higher categories. In the last part of the section, laboratory data on the physical and chemical properties of selected soils are given.

Factors of Soil Formation

The characteristics of the soil at any given point are determined by the physical and mineralogical composition of the parent material, the climate under which the parent material accumulated and has existed since accumulation, the plant and animal life on and in the soil, the relief, or lay of the land, and the length of time the forces of soil formation have acted on the soil material.

Climate and plant and animal life, chiefly plants, are the active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it to a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. Time is needed for changing the parent material into a soil profile. Usually, a long time is required for the development of distinct horizons.

The factors of soil formation are so closely interrelated that few generalizations can be made about the effects of any one factor unless conditions are specified for the other four. Many of the processes of soil development are unknown.

Parent material

Parent material is the unconsolidated mass from which a soil forms. It determines the chemical and mineralogical composition of the soil.

Most of the parent materials in St. Joseph County were deposited by glaciers or by melt water from the glaciers. These glaciers covered the county about 12,000 to 15,000 years ago. Although most of the parent materials are of common origin, their properties can vary greatly within small areas depending on how the materials were deposited. The dominant parent materials in St. Joseph County were deposited as glacial till, outwash, alluvium, and organic material.

The glacial till and outwash were deposited during the Cary substage of the last advance of the Wisconsin age glaciation. Two primary lobes of the ice sheet deposited the materials in St. Joseph County: the Huron-Saginaw lobe and the Michigan lobe.

The Huron-Saginaw lobe accounts for the glacial till that was deposited in the southern half of the county and for the till plain or ground moraine, end moraines, and outwash plain. The nearly level till plain is in the southeastern part of the county. It consists of compact glacial till that was deposited beneath a moving glacier. Crosier and Brookston soils formed on the till plain. The end moraines are the hilly areas of Dragoon Trails, Erskine Park, and Rum Village Park in Center, Greene, and Lincoln Townships. They were deposited by ice near the glacier margin. The outwash plain north and east of Notre Dame University consists of stratified material deposited by melt water from the glacier. Chelsea, Oshtemo, Tyner, and Tracy soils formed on the outwash plain.

The Michigan lobe accounts for the glacial till that was deposited in the northwestern corner of the county. This area of till is the Valparaiso Moraine. The depressional Milford soils, the nearly level Blount soils, and the rolling Morley soils formed on the Valparaiso Moraine.

The Michigan lobe also is the source of some of the outwash material in the northwestern part of the county. The high bluffs along the west side of the St. Joseph River, Portage Prairie, and the sloping soils around Mud Lake, Bass Lake, and Szmanda Lake were deposited as outwash. These soils are mainly of the Tyner, Oshtemo, Tracy, and Coupee series.

Streams carrying glacial melt water from the south and from the east met at South Bend and flowed westward through the Kankakee channel. These streams left large sandy and gravelly deposits in which Oshtemo, Fox, and similar soils formed.

At one time, a sand bar formed where Tippecanoe Place is now located. It stopped the continuous flow of water west of South Bend, and caused a lake to form in a former stream channel. Grasses and sedges grew around the edges of this lake. When they died, their remains did not decompose but accumulated around the edge of the lake. Later, white cedar and other water-tolerant trees grew by the lake. As these trees died, their residue became a part of the organic accumulation. The lake was eventually filled with organic material in which Adrian, Houghton, Edwards, and Palms soils formed. This area is known as the Kankakee muck flats.

Climate

Climate determines the kind of plant and animal life on and in the soil, the amount of water available for weathering minerals and transporting soil material, and, through its influence on soil temperature, the rate of chemical change in the soil.

The climate in St. Joseph County is cool and humid and is presumably similar to that which existed while the soils were forming. Climate is uniform throughout the county, although its effect is modified locally by runoff, proximity to large bodies of water, and other factors. It accounts for only minor differences in the soils of St. Joseph County.

Plants and animals

Plants and animals influence soil formation mainly by adding organic carbon and nitrogen to the soil. The

kind of organic material in the soil depends on the kind of plants. The remains of these plants accumulate on the surface, decay, and eventually become organic matter. Roots provide channels for downward movement of water through the soil and also add organic matter as they decay. Bacteria in the soil help to break down the organic matter so that it can be used by growing plants.

The vegetation in St. Joseph County was mainly mixed forests. The soils that formed under forests generally have less total organic matter than soils that formed under grass. Morley, Miami, Riddles, Chelsea, Brookston, and Milford soils are examples of soils that formed under forests. In a few wet soils, such as Houghton and Palms soils, sphagnum and other mosses contributed much organic matter.

Relief

Relief has influenced the soils through its effect on natural drainage, erosion, plant cover, and soil temperature. In St. Joseph County, slopes range mostly from 0 to 18 percent. Natural soil drainage ranges from well drained on the ridgetops to very poorly drained in the depressions.

Relief affects runoff and natural drainage. Natural soil drainage determines the color of the soil through its effect on aeration. Runoff is greatest on the steeper slopes, but in low areas water may be ponded temporarily. Water and air move freely through soils that are well drained but slowly through soils that are very poorly drained. In soils that are well aerated, iron compounds are oxidized and give the soils reddish or brownish colors, but in poorly aerated soil the color is generally gray or olive because of the removal or reduction of iron compounds. Tyner soils are well drained, and well aerated, and Brookston soils are poorly aerated, and very poorly drained.

Time

A long time generally is needed for distinct horizons to form in the soil. The difference in the length of time that the parent material has been in place is commonly reflected in the degree of development of the soil profile.

The soils in St. Joseph County range from young to mature. The glacial deposits from which many of the soils formed have been exposed to soil-forming factors long enough for distinct horizons to develop. Some soils, however, formed in recent alluvial sediments that have not been in place long enough for distinct horizons to develop.

The Landes soils are an example of soils that formed in alluvial material. The Miami and Morley soils show how time can affect the leaching of lime from the soil. The solum of the Miami and Morley soils at one time had about the same amount of lime as in the C horizon of these soils today. The Milford soils were submerged under glacial lakes and thus were protected from leaching. In contrast, the Hillsdale soils were above water and were subject to leaching. The difference in the length of time that leaching has taken place is reflected in the Whitaker soils, which are leached of lime to a depth of 42 to 60 inches, and in the Crosier soils, which are limy or calcareous at a depth of 24 to 42 inches.

Classification of the Soils

Soils are classified so that we can more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationships to one another and to the whole environment, and to develop principles that help us to understand their behavior and their response to manipulation. First through classification, and then through use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

The narrow categories of classification, such as those used in detailed soil surveys, allow us to organize and apply knowledge about soils in managing farms, fields, and woodlands, in developing rural areas, in engineering work, and in many other ways. Soils are placed in broad classes to facilitate study and comparison of large areas, such as countries and continents.

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965. Because this system is under continual study, readers interested in developments of the current system should refer to the latest literature available (*7*).

The current system of classification has six categories. Beginning with the broadest, these categories are order, suborder, great group, subgroup, family, and series. In this system the criteria used as a basis for classification are soil properties that are observable and measurable. The properties are chosen, however, so that the soils of similar genesis, or mode of origin, are grouped. In table 11, the soil series of St. Joseph County are placed in family, subgroup, and order of the current system. Classes of the current system are briefly defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The properties used to differentiate among soil orders are those that tend to give broad climatic groupings of soils. Three exceptions to this are the Entisols, Histosols, and Vertisols, which occur in many different climates. Each order is named with a word of three or four syllables ending in *sol* (Moll-i-sol).

SUBORDER. Each order is divided into suborders using those soil characteristics that seem to produce classes with the greatest genetic similarity. The suborders are more narrowly defined than are the orders. The soil properties used to separate suborders are mainly those that reflect either the presence or absence of a water table at a shallow depth; soil climate; the accumulation of clay, iron, or organic carbon in the upper part of the solum; cracking of soils caused by a decrease in soil moisture; and fine stratification. The names of suborders have two syllables. The last syllable indicates the order. An example is *Aquoll* (*Aqu*, meaning water or wet, and *oll*, from Mollisol).

GREAT GROUP. Soil suborders are separated into great groups on the basis of uniformity in the kinds and sequence of soil horizons and features. The horizons used to make separations are those in which clay, carbonates, and other constituents have accumulated

TABLE 11.—*Classification of soil series*

Series	Family	Subgroup	Order
Adrian	Sandy or sandy-skeletal, mixed, euic, mesic	Terric Medisaprists	Histosols.
Alida [1]	Fine-loamy, mixed, mesic	Aquollic Hapludalfs	Alfisols.
Alluvial land	Coarse-loamy, mixed, mesic	Mollic Fluvaquents	Entisols.
Aubbeenaubbee	Fine-loamy, mixed, mesic	Aeric Ochraqualfs	Alfisols.
Blount	Fine, illitic, mesic	Aeric Ochraqualfs	Alfisols.
Brady	Coarse-loamy, mixed, mesic	Aquollic Hapludalfs	Alfisols.
Brems	Mixed, mesic	Aquic Udipsamments	Entisols.
Brookston	Fine-loamy, mixed, mesic	Typic Argiaquolls	Mollisols.
Chelsea	Mixed, mesic	Alfic Udipsamments	Entisols.
Coupee	Fine-loamy over sandy or sandy-skeletal, mixed, mesic	Ultic Hapludalfs (mollic)	Alfisols.
Crosier	Fine-loamy, mixed, mesic	Aeric Ochraqualfs	Alfisols.
Del Rey	Fine, illitic, mesic	Aeric Ochraqualfs	Alfisols.
Edwards	Marly, euic, mesic	Limnic Medisaprists	Histosols.
Elston	Coarse-loamy, mixed, mesic	Typic Argiudolls	Mollisols.
Fox	Fine-loamy over sandy or sandy-skeletal, mixed, mesic	Typic Hapludalfs	Alfisols.
Gilford	Coarse-loamy, mixed, mesic	Typic Haplaquolls	Mollisols.
Hillsdale	Coarse-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Houghton	Euic, mesic	Typic Medisaprists	Histosols.
Landes	Coarse-loamy, mixed, mesic	Fluventic Hapludolls	Mollisols.
Martinsville	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Maumee	Sandy, mixed, mesic	Typic Haplaquolls	Mollisols.
Metea	Loamy, mixed, mesic	Arenic Hapludalfs	Alfisols.
Miami	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Milford	Fine, mixed, mesic	Typic Haplaquolls	Mollisols.
Morley	Fine, illitic, mesic	Typic Hapludalfs	Alfisols.
Oshtemo	Coarse-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Palms	Loamy, mixed, euic, mesic	Terric Medisaprists	Histosols.
Quinn	Coarse-loamy, mixed, mesic	Typic Ochraqualfs	Alfisols.
Rensselaer	Fine-loamy, mixed, mesic	Typic Argiaquolls	Mollisols.
Riddles	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Tedrow	Mixed, mesic	Aquic Udipsamments	Entisols.
Tracy	Coarse-loamy, mixed, mesic	Ultic Hapludalfs	Alfisols.
Troxel	Fine-silty, mixed, mesic	Typic Argiudolls	Mollisols.
Tyner	Mixed, mesic	Typic Udipsamments	Entisols.
Wallkill	Fine-loamy, mixed, nonacid, mesic	Thapto-Histic Fluvaquents	Entisols.
Washtenaw	Fine-loamy, mixed, nonacid, mesic	Typic Haplaquents	Entisols.
Whitaker	Fine-loamy, mixed, mesic	Aeric Ochraqualfs	Alfisols.

[1] The Alida soils in St. Joseph County have a contrasting layer above a depth of 40 inches and are taxadjuncts to the Alida series.

or have been removed and those that have pans that interfere with growth of roots or movement of water. Some soil features used are acidity, climate, composition, and color. The names of great groups have three or four syllables and are made by adding a prefix to the name of the suborder. An example is Haplaquoll *(Hapl,* meaning simple horizons, *aqu* for wetness or water, and *oll* from Mollisols).

SUBGROUP. Great groups are divided into subgroups, one representing the central (typic) segment of the group, and others, called intergrades, that have properties of the group and also one or more properties of another great group, suborder, or order. Other subgroups may have soil properties unlike those of any other great group, suborder, or order. The names of subgroups are derived by placing one or more adjectives before the name of the great group. An example is Typic Haplaquolls (a typical Haplaquoll).

FAMILY. Soil families are separated within a subgroup primarily on the basis of properties important to the growth of plants or to the behavior of soils when used for engineering. Among the soil properties considered are texture, mineralogy, reaction, temperature, permeability, depth, and consistence. A family name consists of a series of adjectives preceding the subgroup name. The adjectives are the class names for texture, mineralogy, and so on, that are used to differentiate families (see table 11). An example is the coarse-loamy, mixed, mesic family of Typic Haplaquolls.

Laboratory Data [5]

The physical and chemical properties of soils of the Crosier, Del Rey, Hillsdale, and Riddles series in St. Joseph County are shown in table 12. Particle-size distribution and content of organic carbon were determined by soil scientists in the Purdue Agronomy Laboratory. Reaction, extractable phosphorus, and extractable potassium were determined by the Purdue Plant and Soil Analysis Laboratory.

[5] DR. DONALD P. FRANZMEIER, associate professor of agronomy, Purdue University, helped prepare this section.

TABLE 12.—*Physical and chemical*

Soil	Depth from surface	Horizon	Particle-size distribution			
			Very coarse sand (2–1 mm)	Coarse sand (1–0.5 mm)	Medium sand (0.5–0.25 mm)	Fine sand (0.25–0.10 mm)
	Inches		*Percent*	*Percent*	*Percent*	*Percent*
Crosier loam.	0–8	Ap	0.8	5.5	11.8	15.6
	8–11	A2	.9	6.3	14.0	17.6
	11–20	B21t	.5	4.2	8.8	13.1
	20–30	B22t	1.8	6.1	10.4	14.4
	30–38	B3	1.8	3.9	5.8	9.6
	38–60	C	2.2	5.7	7.8	11.2
Del Rey silt loam.	0–9	Ap	.2	2.6	4.6	7.8
	9–13	B1t	.1	1.4	2.6	3.7
	13–24	B21t	----	.3	1.1	1.9
	24–36	B22t	----	.1	----	.6
	36–42	B31	.1	.1	.1	15.9
	42–48	B32	.1	.5	.5	.8
	48–58	C1	----	----	----	.7
	58–72	C2	----	1.3	1.2	5.6
Hillsdale sandy loam.	0–8	Ap	3.1	10.1	19.9	30.0
	8–12	A2	4.3	10.8	18.9	27.7
	12–24	B21t	3.9	8.5	15.7	23.4
	24–33	B22t	4.4	13.5	19.9	24.0
	33–39	B23t	6.0	10.4	14.8	19.2
	39–52	B31	4.0	8.5	15.0	31.8
	52–63	B32	4.0	8.4	14.0	39.7
	63–72	C	.1	.7	1.6	38.6
Riddles loam.	0–9	Ap	1.4	4.6	9.1	12.5
	9–12	B1	.2	2.5	5.3	8.8
	12–21	B21t	.3	2.2	4.2	8.1
	21–30	B22t	.1	1.5	3.2	7.1
	30–46	B23t	1.0	2.6	5.1	9.6
	46–62	B3	3.6	8.1	13.0	19.2
	62–72	C	.7	2.7	4.8	8.6

Samples were taken in 1970 and 1971 from the profiles described in the section "Descriptions of the Soils." The samples were thoroughly mixed, air dried, and divided to obtain a sample of about 1 pint for testing. Soil material larger than three-fourths inch was sieved out; it was estimated by volume. The material smaller than three-fourths inch was sieved to obtain two samples: material larger than 2 millimeters and material smaller than 2 millimeters. These samples were weighed in the laboratory to obtain the percent of material between 2 millimeters and three-fourths inch. All samples were granulated in the field while moist by rubbing through a one-fourth inch screen and then air dried.

To obtain particle-size distribution, organic matter was destroyed if the organic carbon content was more than 2 percent. Clay content was determined after dispersion by a Calgon solution and overnight shaking. Following the clay determination, the suspension was passed through a No. 50 sieve and the same fraction was collected, dried, and weighed. Silt content was determined by difference.

Oxidizable organic carbon was determined by the Walkley-Black method, which involves oxidation of organic carbon by potassium dichromate and sulfuric acid.

Reaction was determined using a glass electrode pH meter on a 1:1 soil-water suspension.

Extractable phosphorus was determined by the Bray P-1 test. The soil was extracted with a 0.025*N* HCl and 0.03*N* NH_4F solution, and phosphorus was determined by the molybdophosphoric blue colorimetric method.

The textural class and pH values as determined in the laboratory may differ somewhat from those estimated in the profile description.

The combined influence of several soil-forming processes is demonstrated by the data for the Riddles soil in table 12. Most of the soil profile, except the B3 horizon, probably formed in material similar to the C horizon because the percentage of sand and silt are similar throughout the profile.

Plant roots released hydrogen ions (H+) to the soil as they took up basic cations, such as Ca ++, Mg++, and K+. Hydrogen ions combined with rainwater to

properties of selected soils

Particle-size distribution—Continued				USDA textural class	Organic carbon	Reaction 1:1	Extractable cations	
Very fine sand (0.10–0.05 mm)	Silt (0.05–0.002 mm)	Clay (smaller than 0.002 mm)	Particles (coarser than 2 mm)				Phosphorus	Potassium
Percent	*Percent*	*Percent*	*Percent*		*Percent*	*pH*	*Pounds per acre*	*Pounds per acre*
8.8	43.3	14.2		Loam	1.27	6.3	40	165
7.4	38.6	15.2		Loam	.29	6.2	2	120
8.5	36.5	28.4		Clay loam		6.3	2	210
11.0	29.9	26.4		Clay loam		6.7	3	180
17.0	47.4	14.5	4.4	Loam		8.1	5	75
10.8	49.1	13.2	7.1	Loam		8.1	1	75
8.5	59.4	16.9	1.0	Silt loam	1.68	6.7	56	195
1.5	58.5	32.2	1.0	Silty clay loam	.79	5.3	4	195
1.2	50.8	44.7	1.0	Silty clay		5.2	2	240
.5	57.5	41.3	1.0	Light silty clay		5.8	12	180
45.7	25.8	12.3	1.0	Sandy loam		6.6	6	75
1.6	75.1	22.3	1.0	Silt loam		6.6	3	135
4.1	58.4	36.8		Silty clay loam		7.3	3	180
4.0	78.7	9.2	1.0	Silt loam		7.9	1	45
11.3	19.6	5.9	6.4	Silt loam	.56	5.6	18	30
8.6	23.6	6.1	11.1	Silt loam	.10	5.8	8	30
9.5	14.9	24.0	8.4	Silty clay loam		5.9	2	180
6.6	16.0	15.6	10.0	Silt loam		5.9	8	135
8.6	29.8	11.2	8.8	Silt loam		6.0	16	90
11.0	22.9	6.8	5.9	Silt loam		6.0	28	45
18.3	12.3	3.3	5.5	Loamy sand		6.2	18	30
44.0	11.0	4.0	1.0	Loamy sand		5.9	32	30
7.7	52.3	12.4	2.0	Loam	.93	6.2	11	90
7.5	47.7	28.0	1.0	Loam		5.4	6	165
7.7	45.3	32.1	1.3	Clay loam		5.2	10	165
8.2	47.7	32.2	1.1	Clay loam, silty clay loam.		5.2	10	165
9.3	44.9	27.5	2.4	Clay loam		6.5	2	135
10.0	27.7	18.4	20.0	Silt loam		5.4	16	105
9.6	52.6	21.0	8.2	Silt		7.9	2	105

form acid solutions that dissolved the lime (calcium carbonate) from the profile and removed the dissolved products by leaching. Hydrogen ions also replaced some of the basic cations held by clay particles in the soil, causing the horizons to become more acid. In the Riddles soil, carbonates have been removed to a depth of 62 inches. Above that depth horizons are quite acid, and below that depth free carbonates are present as shown in the laboratory data by the high pH value (7.9).

The acid soil solution also caused weathering of primary soil minerals to form clay minerals, and the downward movement of the solutions removed clay particles from the A horizon and deposited them in the B2 horizon. Clay movement resulted in a higher percentage of clay in the B2 horizon (28 to 32 percent) than in the A horizon (12 percent). Clay films were deposited on the surfaces of peds in the B horizon when the solutions carrying the clay evaporated, moved into the interior of the peds, or were used by plants. In the classification system, this B horizon is called an argillic horizon, and the soil is in the Alfisol order.

Water moves readily through the Riddles soil. This soil is well aerated and well oxidized, as indicated by the solid dark yellowish-brown color in the upper part of the B2 horizon, which is a result of the coatings of oxidized iron compounds on the soil particles. Organic matter, mainly from tree leaves, accumulated on the surface of the Riddles soil but was incorporated in the upper horizons when the soil was plowed.

These same processes have been operating in the other soils of the county, but at different rates. The genesis of the Hillsdale soil was similar, but it formed in a sandier parent material that may have been influenced more by glacial meltwater.

Climate [6]

The climate of St. Joseph County is modified considerably by Lake Michigan, which is about 30 miles to the northwest. The lake increases cloudiness, snow, and rain and reduces temperature extremes in both summer and winter. Table 13 gives temperature and precipitation data from records kept at South Bend, and table 14 gives probabilities of the last freezing temperatures in spring and the first in fall.

The temperatures at the National Weather Service Office at the South Bend Airport range from 22° below zero, recorded on January 20, 1943, to 109° F, recorded on July 24, 1934. The temperature reaches 90° F or higher on an average of 10 days per year. The temperature is zero or less on an average of 8 days per year. These averages are considerably less than for those areas that are at the same latitude but that are farther west and are not influenced by Lake Michigan.

Precipitation is rather uniform throughout the year; it averages a little less than 2 inches in February and about 3.5 inches in spring and summer. During the average year, 141 days have 0.01 inch or more of precipitation. December and January average 15 such days, but the number declines to 9 per month in the late summer and fall.

Thunderstorms occur on about 43 days a year, most commonly in midsummer. Occasionally they cause high winds and brief heavy rains, and the most severe may cause one or two tornadoes. In a 53-year period, 19 tornadoes have been observed in the county. On April 11, 1965, more than four tornadoes tore through the county and killed a number of people.

From observations over a 9-year period, the lowest average relative humidity, 53 percent, occurs in May at 1 p.m. The highest average, 89 percent, occurs in September at 7 a.m. The relative humidity fluctuates inversely with air temperature on most days.

Heavy fog is reported on an average of 24 days a year. Fog is most prevalent in winter when 2 or 3 days a month have heavy fog. The least fog occurs in summer.

St. Joseph County is near the center of maximum snowfall in Indiana. The average annual snowfall is 66 inches. The maximum occurring in 24 hours is 15.6 inches, which was reported January 26, 1967.

Because this county is near Lake Michigan, there is more cloudiness here than farther south. About 188 days of the year are cloudy, 105 days are partly cloudy, and 72 days are clear.

Winds at 21 feet above the ground average 8 miles per hour in August and 12.4 miles per hour in March, the windiest month of the year. The prevailing wind direction is south-southwest in summer and fall and north-northwest in March and April.

As shown in table 14, the average growing season is 166 days long. The length of the growing season increases toward Lake Michigan by 10 to 20 days.

Additional Facts About the County [7]

The Potowatomi Indians and some Miami Indians were the original inhabitants of St. Joseph County. The first European explorers were Marquette in 1673 and LaSalle in 1679. Pierre Navarre was the first European settler; he established a trading post in South Bend in 1820.

The county was established by the Indiana Legislature in 1830. Mishawaka was incorporated as a town in 1834, and South Bend was incorporated in 1835.

The settlers followed Indian trails in establishing their transportation system. The most important trails were the Portage Trail, from the St. Joseph River to the Kankakee River; the Great Sauk Trail, from Chicago to Detroit; and the Dragoon Trail, from Chicago to Fort Wayne. The Michigan Road, which linked South Bend with Madison, Indiana, was built through the county in 1832.

The first industries in the county were established in the 1830's. The Studebaker Wagon Works was established in 1852, and other large manufacturing firms after that.

[6] By LAWRENCE A. SCHAAL, climatologist for Indiana, National Weather Service, U.S. Department of Commerce, and Purdue University, Agronomy Department.

[7] By JAMES R. GETTINGER, district conservationist, Soil Conservation Service.

TABLE 13.—*Temperature and precipitation*

[Data from National Weather Service, South Bend Airport, elevation 768 feet, for the period 1931–72]

Month	Temperature				Precipitation				
	Average daily maximum	Average daily minimum	Average monthly maximum	Average monthly minimum	Average monthly total	One year in 10 will have—		Days with snow cover of 1 inch or more	Average depth of snow on days with snow cover of 1 inch or more
						Less than—	More than—		
	°F	°F	°F	°F	*Inches*	*Inches*	*Inches*	*Number*	*Inches*
January	33	18	50	−9	2.2	1.1	4.2	25	5
February	35	19	52	−3	1.9	.9	3.2	22	6
March	43	26	69	8	2.7	1.5	4.3	12	4
April	58	37	79	24	3.6	1.9	5.6	1	3
May	70	48	86	33	3.6	1.3	5.9	0	0
June	80	58	92	44	3.6	1.6	5.8	0	0
July	85	63	92	50	3.5	1.5	6.0	0	0
August	83	61	91	48	3.6	1.2	5.4	0	0
September	74	53	88	38	3.1	1.1	5.4	0	0
October	64	43	81	29	3.2	.9	5.4	(1)	2
November	47	31	67	17	2.7	1.5	4.1	5	3
December	36	22	57	−2	2.2	.9	4.6	17	5
Year	59	40	[2] 94	[3] −11	35.9	28.8	42.5	82	5

[1] Less than one-half day. [2] Average annual highest temperature. [3] Average annual lowest temperature.

TABLE 14.—*Probabilities of last freezing temperatures in spring and first in fall*

[Based on data from South Bend, elevation 768 feet, for the period 1921–60]

Probability	Dates for given probability and temperature				
	16° F or lower	20° F or lower	24° F or lower	28° F or lower	32° F or lower
Spring:					
1 year in 10 later than	March 28	April 13	April 19	May 6	May 18
2 years in 10 later than	March 23	April 7	April 14	May 1	May 13
5 years in 10 later than	March 13	March 25	April 5	April 22	May 3
Fall:					
1 year in 10 earlier than	November 12	November 6	October 27	October 15	October 1
2 years in 10 earlier than	November 18	November 11	October 31	October 21	October 5
5 years in 10 earlier than	November 29	November 21	November 10	October 31	October 16

In 1830, the population of St. Joseph County was about 300. It had increased to 28,162 by 1870 and to 245,045 by 1970.

Farming in St. Joseph County is following the national trend to larger farms and fewer operators. The number of farms decreased from 1,442 in 1964 to 1,364 in 1969. The total land used for farm purposes decreased from 197,715 acres in 1964 to 194,835 acres in 1969.

Cash-grain farming is the most important type, but high-value specialty crops are also important. Mint, potatoes, and onions are produced in the county, generally on the muck soils.

St. Joseph County is a key center in the Great Lakes industrial belt. The industry is extremely diversified. More than 36,000 people are employed in more than 350 manufacturing firms, and 55,000 people are employed in nonmanufacturing industries. The county is also a center of trade for north-central Indiana and southwestern Michigan. It has more than 3,300 retail and 500 wholesale establishments.

St. Joseph County is within a highly developed transportation network. The area is served by 68 motor carriers and six railroad systems, as well as the Chicago, South Shore, and South Bend Electric Railway, which runs directly to Chicago. Bus service is provided by six buslines. The St. Joseph County Airport provides major airline service to principal cities of the United States. Major roadways include U.S. Highways 6, 20, 31, and 33; Indiana Highways 2, 4, 23, 123, and 331; the Northern Indiana Toll Road; and Interstate Highways 80 and 90.

Drainage

The drainage divide between the Mississippi Basin and the Great Lakes Basin crosses St. Joseph County. About two-thirds of the county drains into the Kankakee River system, which flows to the Mississippi River, and one third drains into the St. Joseph River system, which flows into Lake Michigan. The principal tributaries of the Kankakee River, which begins in the county, are the Yellow River, Grapevine Ditch, Niespodziany Ditch, Pine Creek, and Yellow Bank Creek. The principal tributaries of the St. Joseph River are Baugo Creek, Juday Creek, Eutzler Ditch, Woodward Ditch, and Bowman Creek.

Water Supply

In St. Joseph County, the water supply for farms, homes, and industry generally comes from wells. In 1962, the Indiana Department of Conservation reported that "adequate quantities of ground water are available for domestic, stock, public, and industrial supplies from sand and gravel of Pleistocene Age." The report also pointed out that the rocks of Devonian and Mississippian Age are a potential source of ground water (*3*).

Direct precipitation and surface water storage is a potential source of irrigation water for high-value specialty crops.

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Glossary

Aeration, soil. The exchange of air in the soil with air from the atmosphere. The air in a well-aerated soil is similar to that in the atmosphere; but that in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as crumbs, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Available water capacity (also termed available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonyms: clay coat, clay skin.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds, or of soil grains cemented together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Contour farming. Plowing, cultivating, planting, and harvesting in rows that are at right angles to the natural direction of the slope or that are parallel to terrace grade.

Cover crop. A close-growing crop grown primarily to improve and to protect the soil between periods of regular crop production; or a crop grown between trees and vines in orchards and vineyards.

Depth, soil. The depth of the soil profile over bedrock or other strongly contrasting, nonconforming rock material. Depth classes used to describe soils in this survey are—

Shallow	20 inches or less
Moderately deep	20 to 40 inches
Deep	40 inches or more

Diversion, or diversion terrace. A ridge of earth, generally a terrace, that is built to divert runoff from its natural course and, thus, to protect areas downslope from the effects of such runoff.

Drainage, internal soil. The downward movement of water through the soil profile. The rate of movement is determined by the texture, structure, and other characteristics of the soil and underlying layers and by the height of the water table, either permanent or perched. Relative terms for expressing internal drainage are none, very slow, slow, medium, rapid, and very rapid.

Drainage class (natural). Refers to the conditions of frequency and duration of periods of saturation or partial saturation that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low available water capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A and upper B horizons and mottling in the lower B and the C horizons.

Somewhat poorly drained soils are wet for significant periods but not all the time, and some soils commonly have mottling at a depth below 6 to 16 inches.

Poorly drained soils are wet for long periods and are light gray and generally mottled from the surface downward, although mottling may be absent or nearly so in some soils.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Drift (geology). Material of any sort deposited by geologic processes in one place after having been removed from another; includes drift materials deposited by glaciers and by streams and lakes associated with them.

Erosion. The wearing away of the land surface by wind (sandblast), running water, and other geological agents.

Esker (geology). A narrow, winding ridge or mound of stratified gravelly and sandy drift that was deposited by a subglacial stream.

Flood plain. Nearly level land, consisting of stream sediments, that borders a stream and is subject to flooding unless protected artificially.

Glacial outwash (geology). Cross-bedded gravel, sand, and silt deposited by melt-water as it flowed from glacial ice.

Glacial till (geology). Unassorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Green manure. A crop grown for the purpose of being turned under in an early stage of maturity or soon after maturity for soil improvement.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Lacustrine deposit (geology). Material deposited in lake water and exposed by lowering of the water level or elevation of the land.

Leaching. The removal of soluble materials from soils or other material by percolating water.

Mineral soil. Soil composed mainly of inorganic (mineral) material and low in content of organic material. Its bulk density is greater than that of organic soil.

Moraine (geology). An accumulation of earth, stones, and other debris deposited by a glacier. Types are these: Terminal, lateral, medial, ground.

Mottling, soil. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent.* The size measurements are these: *fine,* less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium,* ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inches) in diameter along the greatest dimension; and *coarse,* more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Munsell notation. A system for designating color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with a hue of 10YR, a value of 6, and a chroma of 4.

Organic soil. A general term applied to a soil or soil horizon that consists primarily of organic matter, such as peat soils, muck soils, and peaty soil layers. In chemistry, organic refers to the compounds of carbon.

Ped. An individual natural soil aggregate, such as a crumb, a prism, or a block, in contrast to a clod.

Permeability. The quality that enables the soil to transmit water or air. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour," soil is one that gives an acid

reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Sand. Individual rock or mineral fragments in a soil that range in diameter from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Stripcropping. Growing crops in a systematic arrangement of strips, or bands, to serve as vegetative barriers to wind and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles) adhering together without any regular cleavage, as in many claypans and hardpans.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. Technically, the part of the soil below the solum.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches in thickness. The plowed layer.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand*, *loamy sand*, *sandy loam*, *loam*, *silt loam*, *silt*, *sandy clay loam*, *clay loam*, *silty clay loam*, *sandy clay*, *silty clay*, and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Topsoil. A presumed fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

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GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and that of the soil series to which it belongs.

Map symbol	Mapping unit	Described on page	Capability unit		Special crop group	Tree and shrub group	Woodland group
			Symbol	Page			
Ad	Adrian muck, drained	12	IVw-3	46	1	1	4w23
AeA	Alida loam, 0 to 2 percent slopes	13	IIw-2	41	2	2	3w5
Am	Alluvial land	13	Vw-3	46	---	---	----
Au	Aubbeenaubbee sandy loam	14	IIw-11	42	2	2	3w5
BbA	Blount silt loam, 0 to 2 percent slopes	14	IIw-2	41	4	2	3w5
Bd	Brady sandy loam	15	IIIw-4	44	2	2	3w20
BeA	Brems fine sand, 0 to 2 percent slopes	15	IVs-1	46	7	6	3s17
Br	Brookston silty clay loam	16	IIw-1	40	3	1	2w11
ChA	Chelsea fine sand, 0 to 5 percent slopes	17	IIIs-1	45	7	6	3s17
ChC	Chelsea fine sand, 5 to 10 percent slopes	17	IIIe-12	43	8	6	3s17
CoA	Coupee silt loam, 0 to 2 percent slopes	17	IIs-2	42	6	6	o23
CtA	Crosier loam, 0 to 2 percent slopes	18	IIw-2	41	2	2	3w5
CtB	Crosier loam, 2 to 4 percent slopes	18	IIw-2	41	2	2	3w5
De	Del Rey silt loam	19	IIw-2	41	4	2	3w5
Ed	Edwards muck	19	IVw-3	46	1	1	4w23
EsA	Elston sandy loam, 0 to 2 percent slopes	20	IIIs-2	45	6	6	o23
FsA	Fox sandy loam, 0 to 2 percent slopes	21	IIs-1	42	6	6	1r2
FsB	Fox sandy loam, 2 to 6 percent slopes	21	IIIe-9	43	6	6	1r2
Gf	Gilford sandy loam	21	IIw-4	41	2	5	4w21
GP	Gravel pits	21	-------	--	---	---	----
HdA	Hillsdale sandy loam, 0 to 2 percent slopes	22	IIs-5	43	6	3	1r2
HdB	Hillsdale sandy loam, 2 to 6 percent slopes	22	IIe-11	40	6	3	1r2
HeC2	Hillsdale complex, 6 to 12 percent slopes, eroded	22	IIIe-15	44	8	3	1r2
HeD2	Hillsdale complex, 12 to 18 percent slopes, eroded	22	IVe-15	45	8	3	1r2
Hm	Houghton muck	23	IIIw-8	44	1	1	4w23
Ho	Houghton muck, drained	23	IIIw-8	44	1	1	4w23
La	Landes loam	24	IIs-7	43	6	3	1o8
Ma	Made land	24	-------	--	---	---	----
Mc	Marsh	24	-------	--	---	---	----
MeA	Martinsville loam, 0 to 2 percent slopes	25	I-1	40	5	3	1o1
MeB2	Martinsville loam, 2 to 6 percent slopes, eroded	25	IIe-3	40	5	3	1o1
MeC2	Martinsville loam, 6 to 12 percent slopes, eroded	25	IIIe-1	43	5	3	1o1
Mf	Maumee loamy fine sand	25	IIIw-1	44	2	5	4w21
Mg	Maumee mucky loamy fine sand	25	IIIw-1	44	2	5	4w21
MkB	Metea loamy fine sand, 4 to 10 percent slopes	26	IIIe-13	44	6	6	2s15
MmB	Miami loam, 2 to 6 percent slopes	27	IIe-1	40	5	3	1o1
MmC2	Miami loam, 6 to 12 percent slopes, eroded	27	IIIe-1	43	8	3	1o1
MoC3	Miami clay loam, 6 to 12 percent slopes, severely eroded	27	IVe-1	45	8	3	1o1
MoD3	Miami clay loam, 12 to 18 percent slopes, severely eroded	27	VIe-1	46	8	3	1o1
Mp	Milford silty clay loam	28	IIw-1	40	3	1	2w11
MrB2	Morley silt loam, 2 to 6 percent slopes, eroded	28	IIe-6	40	5	3	1o1
MrC2	Morley silt loam, 6 to 12 percent slopes, eroded	28	IIIe-6	43	8	3	1o1
MsD3	Morley silty clay loam, 12 to 18 percent slopes, severely eroded	28	VIe-6	46	8	3	1o1
OsA	Oshtemo sandy loam, 0 to 2 percent slopes	29	IIIs-2	45	6	6	3s17
OsB	Oshtemo sandy loam, 2 to 6 percent slopes	29	IIIe-13	44	6	6	3s17
OsC2	Oshtemo sandy loam, 6 to 12 percent slopes, eroded	29	IIIe-13	44	8	6	3s17

Map symbol	Mapping unit	De-scribed on page	Capability unit		Special crop group	Tree and shrub group	Woodland group
			Symbol	Page			
OsD	Oshtemo sandy loam, 12 to 18 percent slopes----	29	IVe-13	45	8	6	3s17
Pa	Palms muck, drained----------	31	IIw-10	41	1	1	4w23
Qu	Quinn loam----------	32	IIIw-12	44	2	1	2w11
Re	Rensselaer loam----------	32	IIw-1	40	2	5	2w11
Rm	Rensselaer mucky loam----------	33	IIw-1	40	2	5	2w11
RtA	Riddles loam, 0 to 2 percent slopes----------	33	I-1	40	5	3	1o1
RtB	Riddles loam, 2 to 6 percent slopes----------	33	IIe-1	40	5	3	1o1
RtC2	Riddles loam, 6 to 12 percent slopes, eroded---	33	IIIe-1	43	8	3	1o1
RtD2	Riddles loam, 12 to 18 percent slopes, eroded--	34	IVe-1	45	8	3	1o1
Te	Tedrow fine sand----------	34	IIIw-4	44	2	2	3w20
TrA	Tracy sandy loam, 0 to 2 percent slopes--------	35	IIs-5	43	5	6	3s17
TrB	Tracy sandy loam, 2 to 6 percent slopes--------	35	IIe-3	40	5	6	3s17
TrC2	Tracy sandy loam, 6 to 12 percent slopes, eroded----------	35	IIIe-13	44	5	6	3s17
Tx	Troxel silt loam----------	36	I-1	40	5	6	o23
TyA	Tyner loamy sand, 0 to 6 percent slopes--------	36	IIIs-1	45	7	6	3s17
TyC	Tyner loamy sand, 6 to 12 percent slopes-------	36	IVe-12	45	8	6	3s17
TyD	Tyner loamy sand, 12 to 18 percent slopes------	36	VIe-12	46	8	6	3s17
Wk	Wallkill silt loam----------	37	IIw-7	41	2	1	4w23
Ws	Washtenaw silt loam----------	38	IIw-1	40	2	1	2w11
Wt	Whitaker loam----------	38	IIw-2	41	2	2	3w5

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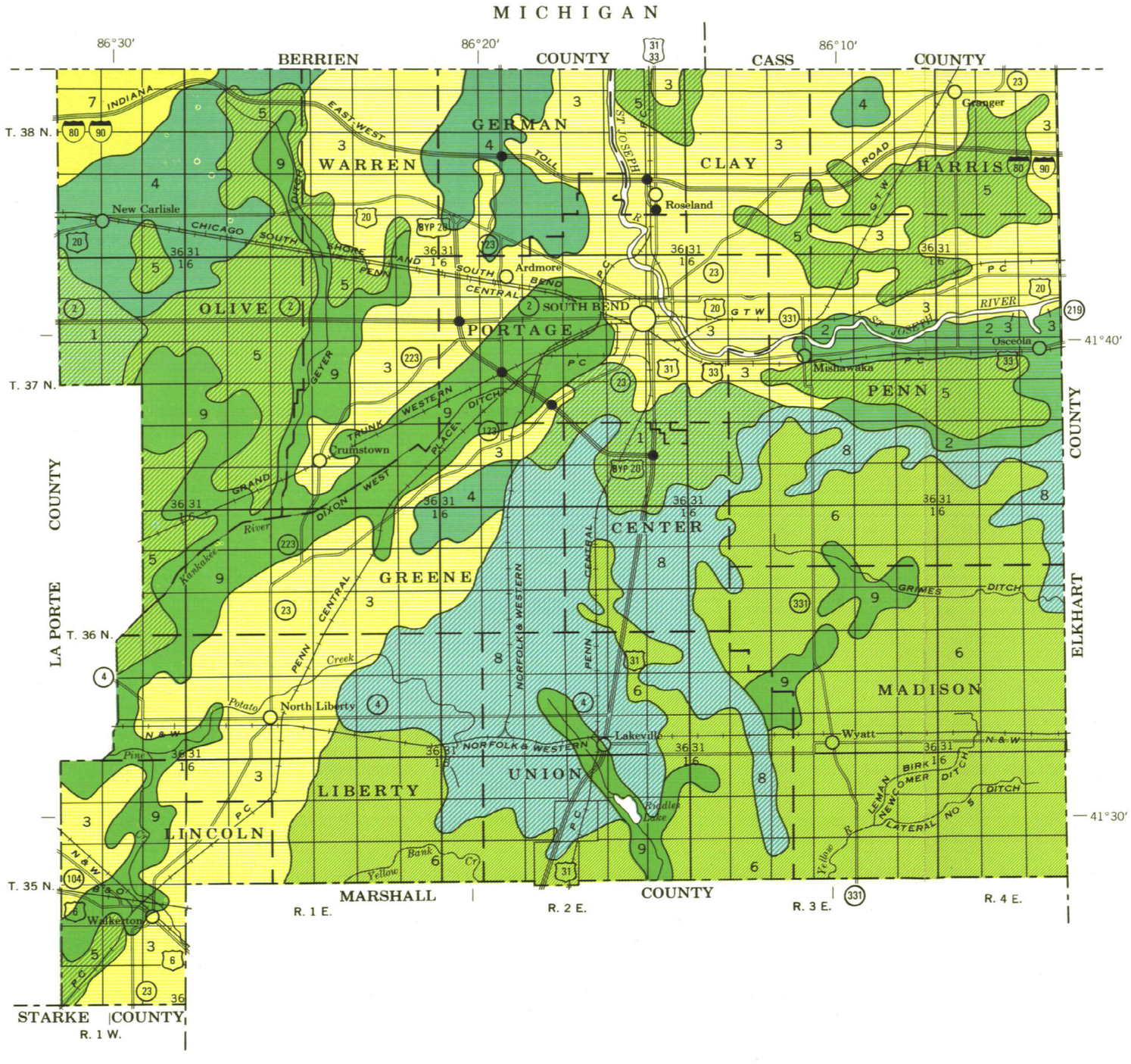


SOIL ASSOCIATIONS

DOMINANTLY WELL-DRAINED TO EXCESSIVELY DRAINED, NEARLY LEVEL TO STRONGLY SLOPING SOILS

1 — Hillsdale-Oshtemo-Chelsea association: Deep, nearly level to strongly sloping, well-drained and excessively drained, moderately coarse textured and coarse textured soils on till plains, moraines, outwash plains, and terraces

2 — Oshtemo-Fox association: Nearly level to strongly sloping, well-drained, moderately coarse textured soils that are deep and moderately deep over sand and gravelly sand; on outwash plains and terraces

3 — Tyner-Oshtemo association: Deep, nearly level to strongly sloping, well-drained, coarse textured and moderately coarse textured soils on outwash plains and terraces

4 — Coupee-Tracy association: Deep, nearly level to moderately sloping, well-drained, medium-textured and moderately coarse textured soils on outwash plains and terraces

DOMINANTLY SOMEWHAT POORLY DRAINED TO VERY POORLY DRAINED, NEARLY LEVEL, GENTLY SLOPING, AND DEPRESSIONAL SOILS

5 — Rensselaer-Gilford-Maumee association: Deep, depressional and nearly level, very poorly drained, medium-textured, moderately coarse textured, and coarse textured soils on outwash plains

6 — Crosier-Brookston-Milford association: Deep, depressional and nearly level to gently sloping, somewhat poorly drained to very poorly drained, medium-textured to moderately fine textured soils on till plains and lake plains

DOMINANTLY WELL-DRAINED TO SOMEWHAT POORLY DRAINED, NEARLY LEVEL TO STRONGLY SLOPING SOILS

7 — Morley-Blount association: Deep, nearly level to strongly sloping, well-drained to somewhat poorly drained, medium-textured to moderately fine textured soils on till plains and moraines

8 — Riddles-Miami-Crosier association: Deep, nearly level to strongly sloping, well-drained and somewhat poorly drained, medium-textured and moderately fine textured soils on till plains

DOMINANTLY VERY POORLY DRAINED, DEPRESSIONAL AND NEARLY LEVEL, ORGANIC SOILS

9 — Houghton-Adrian-Palms association: Deep, depressional and nearly level, very poorly drained, organic soils on lake plains, outwash plains, and till plains

Compiled 1976

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
PURDUE UNIVERSITY AGRICULTURAL EXPERIMENT STATION

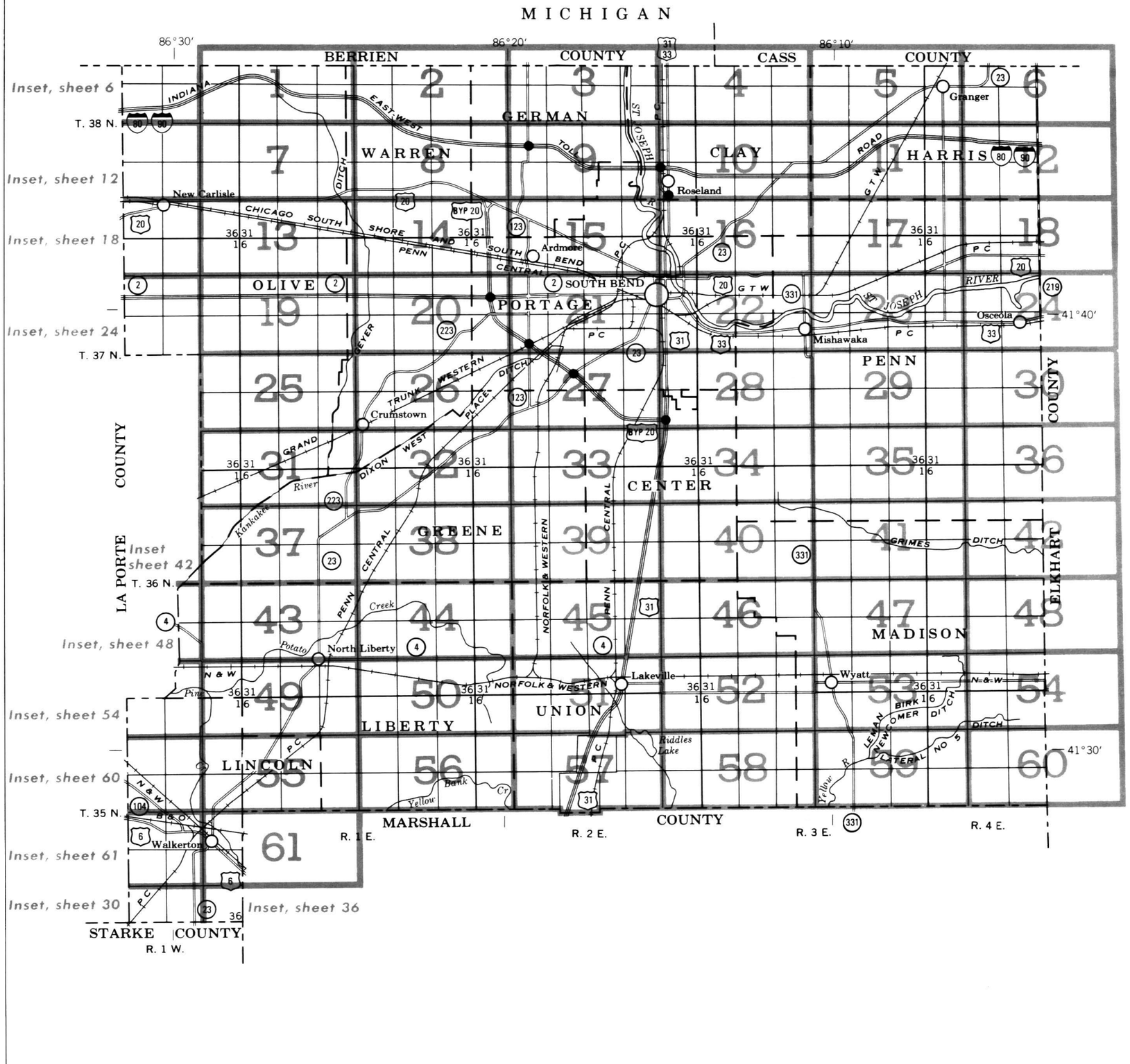
GENERAL SOIL MAP
ST. JOSEPH COUNTY, INDIANA

Scale 1:190,080
1 0 1 2 3 4 Miles

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.



INDEX TO MAP SHEETS
ST. JOSEPH COUNTY, INDIANA

Scale 1:190,080

1 0 1 2 3 4 Miles

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

SOIL LEGEND

The first capital letter is the initial one of the series name. A second capital letter, A, B, C, or D, shows the slope. Most symbols without a slope letter are those for level or nearly level soils but some are for miscellaneous land types. A final number, 2 or 3, in the symbol shows that the soil is eroded or severely eroded.

SYMBOL	NAME
Ad	Adrian muck, drained
AeA	Alida loam, 0 to 2 percent slopes
Am	Alluvial land
Au	Aubbeenaubbee sandy loam
BbA	Blount silt loam, 0 to 2 percent slopes
Bd	Brady sandy loam
BeA	Brems fine sand, 0 to 2 percent slopes
Br	Brookston silty clay loam
ChA	Chelsea fine sand, 0 to 5 percent slopes
ChC	Chelsea fine sand, 5 to 10 percent slopes
CoA	Coupee silt loam, 0 to 2 percent slopes
CtA	Crosier loam, 0 to 2 percent slopes
CtB	Crosier loam, 2 to 4 percent slopes
De	Del Rey silt loam
Ed	Edwards muck
EsA	Elston sandy loam, 0 to 2 percent slopes
FsA	Fox sandy loam, 0 to 2 percent slopes
FsB	Fox sandy loam, 2 to 6 percent slopes
Gf	Gilford sandy loam
GP	Gravel Pits
HdA	Hillsdale sandy loam, 0 to 2 percent slopes
HdB	Hillsdale sandy loam, 2 to 6 percent slopes
HeC2	Hillsdale complex, 6 to 12 percent slopes, eroded
HeD2	Hillsdale complex, 12 to 18 percent slopes, eroded
Hm	Houghton muck
Ho	Houghton muck, drained
La	Landes loam
Ma	Made land
Mc	Marsh
MeA	Martinsville loam, 0 to 2 percent slopes
MeB2	Martinsville loam, 2 to 6 percent slopes, eroded
MeC2	Martinsville loam, 6 to 12 percent slopes, eroded
Mf	Maumee loamy fine sand
Mg	Maumee mucky loamy fine sand
MkB	Metea loamy fine sand, 4 to 10 percent slopes
MmB	Miami loam, 2 to 6 percent slopes
MmC2	Miami loam, 6 to 12 percent slopes, eroded
MoC3	Miami clay loam, 6 to 12 percent slopes, severely eroded
MoD3	Miami clay loam, 12 to 18 percent slopes, severely eroded
Mp	Milford silty clay loam
MrB2	Morley silt loam, 2 to 6 percent slopes, eroded
MrC2	Morley silt loam, 6 to 12 percent slopes, eroded
MsD3	Morley silty clay loam, 12 to 18 percent slopes, severely eroded
OsA	Oshtemo sandy loam, 0 to 2 percent slopes
OsB	Oshtemo sandy loam, 2 to 6 percent slopes
OsC2	Oshtemo sandy loam, 6 to 12 percent slopes, eroded
OsD	Oshtemo sandy loam, 12 to 18 percent slopes
Pa	Palms muck, drained
Qu	Quinn loam
Re	Rensselaer loam
Rm	Rensselaer mucky loam
RtA	Riddles loam, 0 to 2 percent slopes
RtB	Riddles loam, 2 to 6 percent slopes
RtC2	Riddles loam, 6 to 12 percent slopes, eroded
RtD2	Riddles loam, 12 to 18 percent slopes, eroded
Te	Tedrow fine sand
TrA	Tracy sandy loam, 0 to 2 percent slopes
TrB	Tracy sandy loam, 2 to 6 percent slopes
TrC2	Tracy sandy loam, 6 to 12 percent slopes, eroded
Tx	Troxel silt loam
TyA	Tyner loamy sand, 0 to 6 percent slopes
TyC	Tyner loamy sand, 6 to 12 percent slopes
TyD	Tyner loamy sand, 12 to 18 percent slopes
Wk	Wallkill silt loam
Ws	Washtenaw silt loam
Wt	Whitaker loam

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline & neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery, or flood pool (Davis Airstrip; FLOOD POOL LINE)

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEMS & DESIGNATIONS

- Interstate (79)
- Federal (410)
- State (52)
- County, farm or ranch (378)

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or small (water; w)

PITS

- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label) (Indian Mound)
- Located object (label) (Tower)
- Tank (label) (GAS)
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double-line (label) (CANAL)
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial (water; w)
- Intermittent (int; i)

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS (CeA; FoB2)

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

GULLY

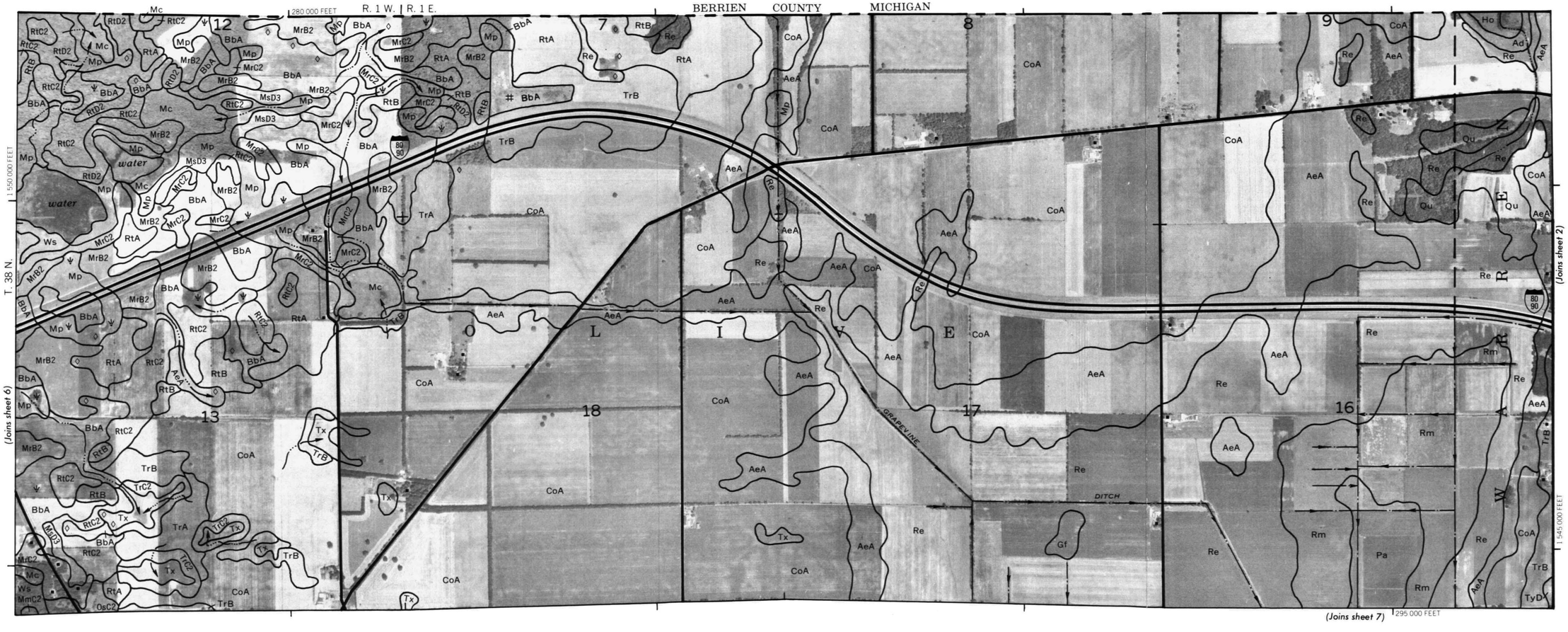
DEPRESSION OR SINK

SOIL SAMPLE SITE (normally not shown)

MISCELLANEOUS

- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot
- Borrow pit
- Iron spot
- Marl spot

ST. JOSEPH COUNTY, INDIANA — SHEET NUMBER 1



ST. JOSEPH COUNTY, INDIANA NO. 1

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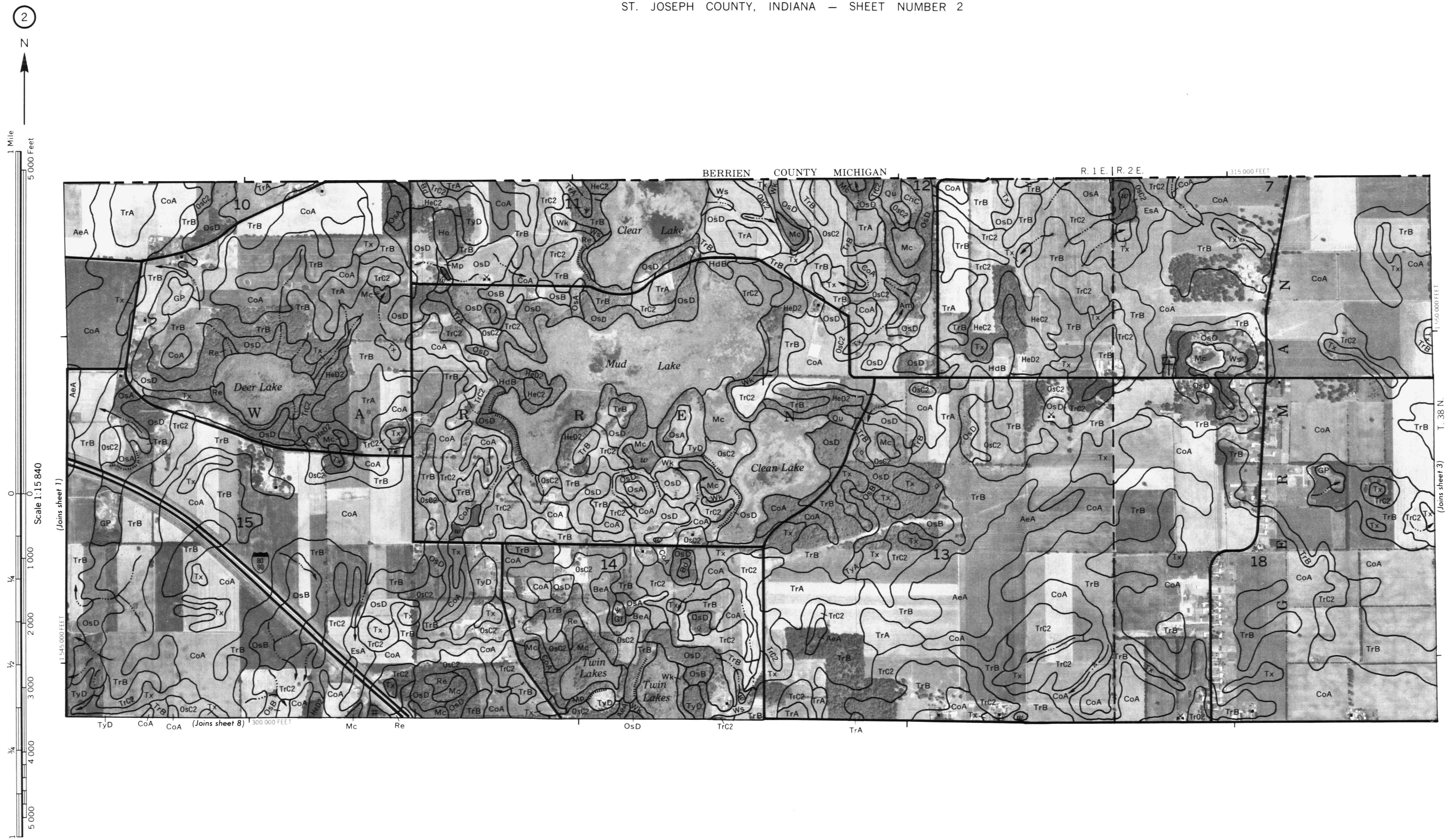
Coordinate grid ticks and land division corners, if shown, are approximately positioned

1

N

1 Mile
5 000 Feet
Scale 1:15 840



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ST. JOSEPH COUNTY, INDIANA NO. 3

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1 Mile
5 000 4 000 3 000 2 000 1 000 0 5 000 Feet
Scale 1:15 840

ST. JOSEPH COUNTY, INDIANA — SHEET NUMBER 3

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ST. JOSEPH COUNTY, INDIANA NO. 4

N

1 Mile
5 000 Feet
Scale 1:15 840
1 000
2 000
3 000
4 000
5 000

ST. JOSEPH COUNTY, INDIANA NO. 5

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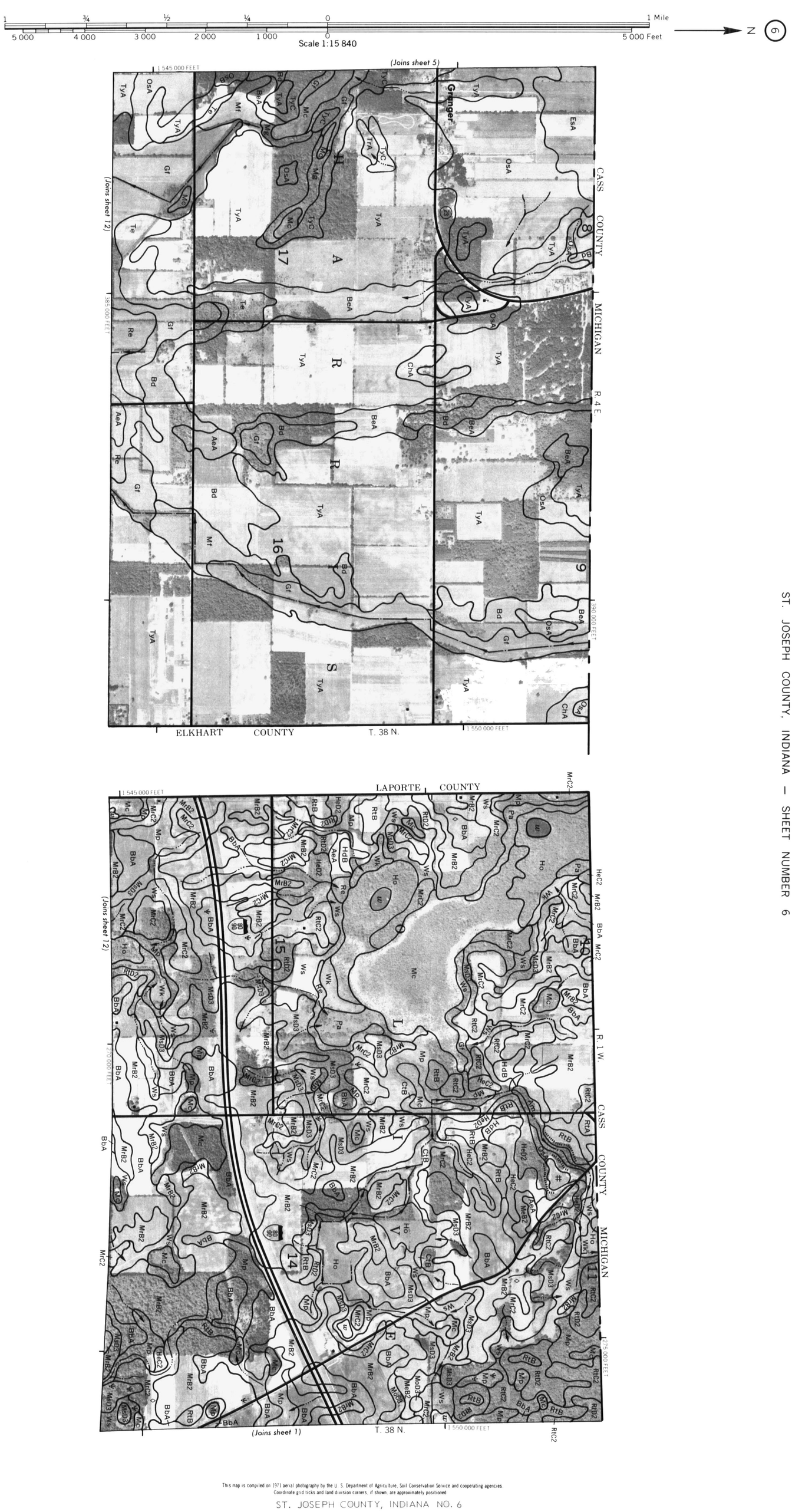

ST. JOSEPH COUNTY, INDIANA — SHEET NUMBER 6

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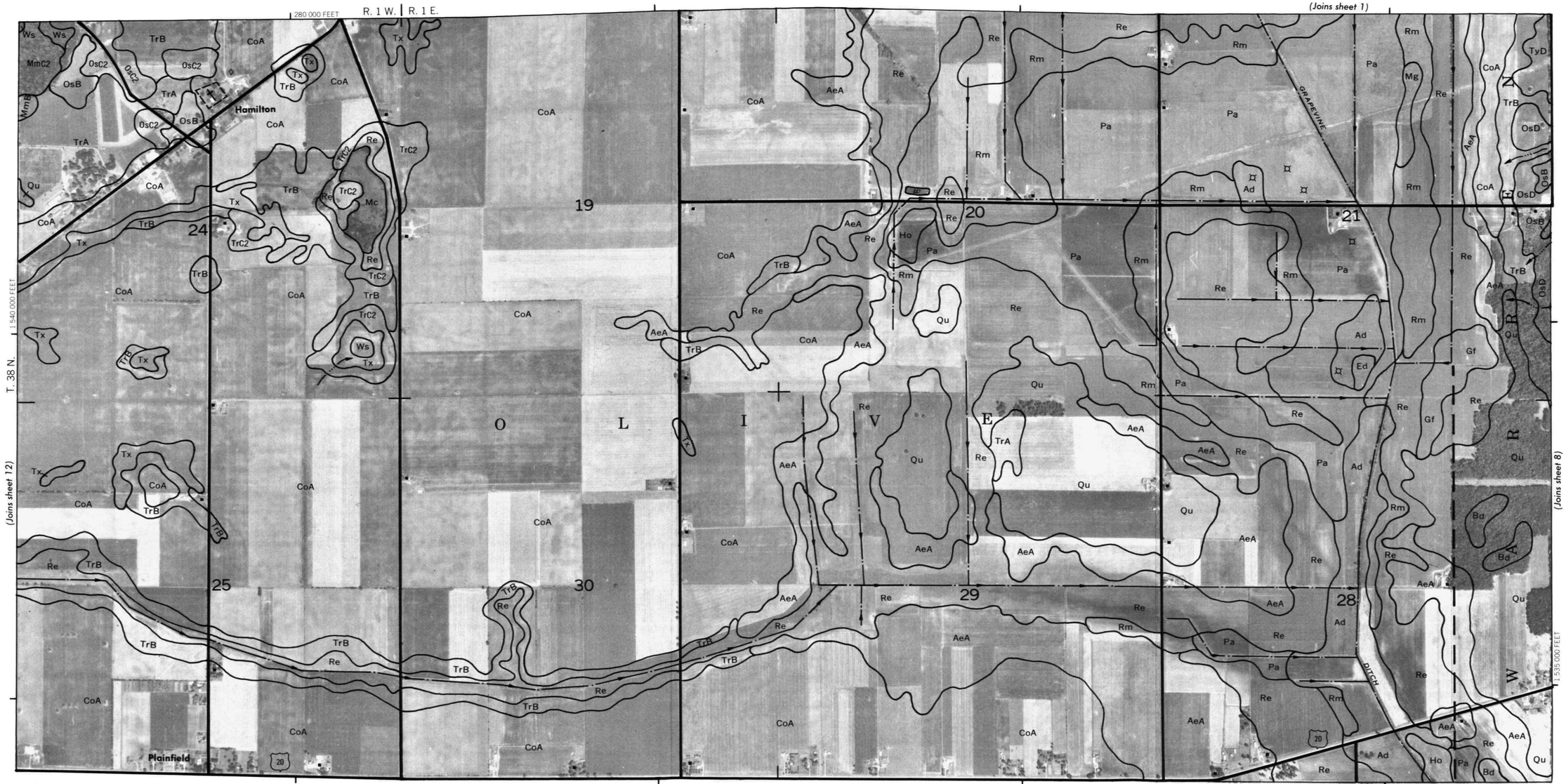
ST. JOSEPH COUNTY, INDIANA NO. 6



8

N

1 Mile

5 000 Feet

Scale 1:15 840

(Joins sheet 2)

(Joins sheet 7)

(Joins sheet 14)

(Joins sheet 9)

535 000 FEET

300 000 FEET

315 000 FEET

340 000 FEET

R. 1 E. | R. 2 E.

T. 38 N.

Turn Lakes

22 23 24 19

27 26 25 30

W A R N E R

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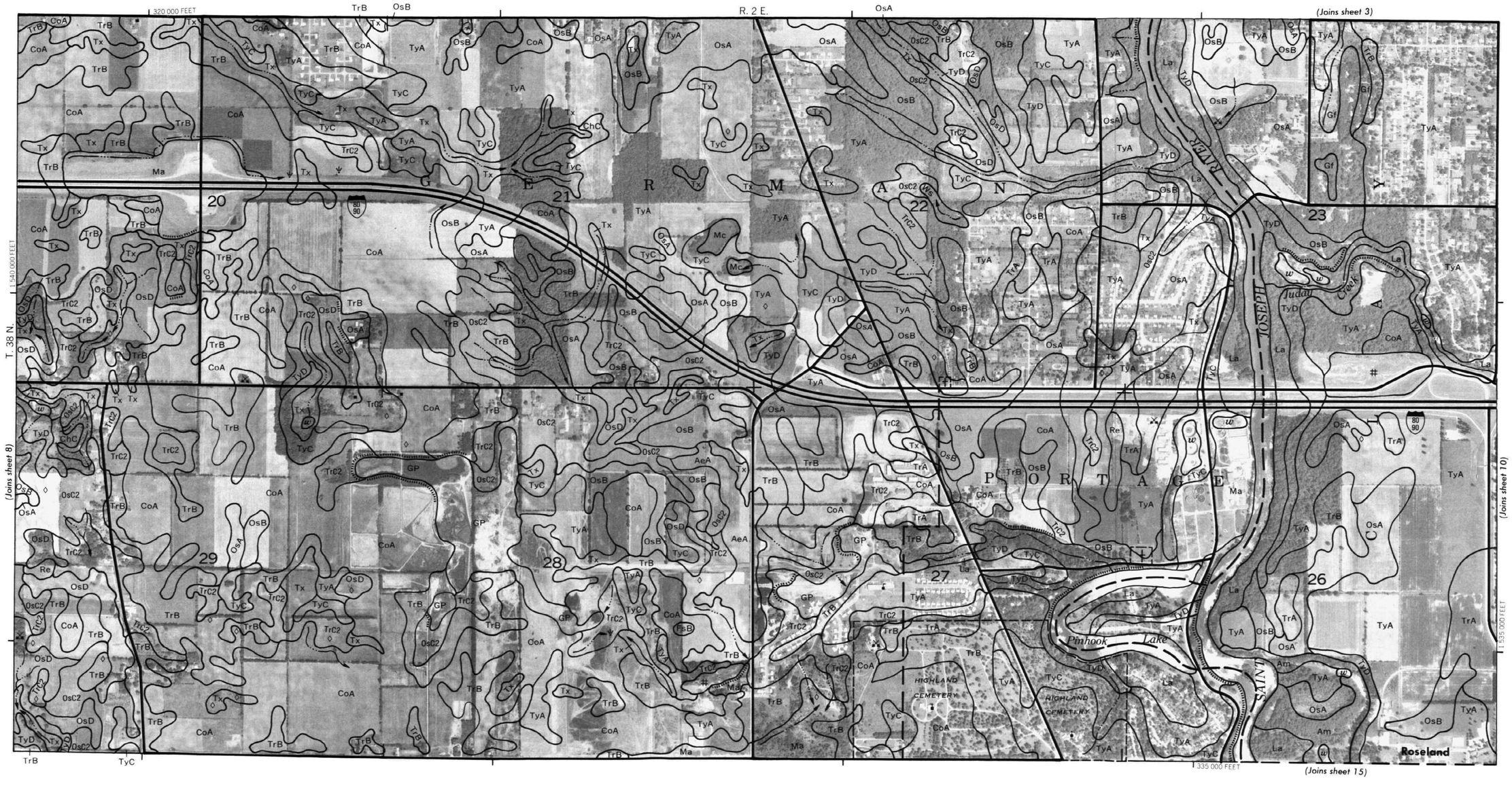
ST. JOSEPH COUNTY, INDIANA NO. 8



ST. JOSEPH COUNTY, INDIANA NO. 9

10

N

1 Mile

5 000 Feet

Scale 1:15 840

0 0

¼ 1 000

½ 2 000

¾ 3 000

1 4 000

5 000

R. 2 E. | R. 3 E.

360 000 FEET

1 540 000 FEET

T. 38 N.

1 535 000 FEET

340 000 FEET

(Joins sheet 4)

(Joins sheet 9)

(Joins sheet 11)

(Joins sheet 16)

CENTRAL

PENN

Roseland

Juday

Indian Village

Creek

UNIVERSITY OF NOTRE DAME

SAINT JOSEPH VALLEY MEMORIAL PARK

19 20 21 24 25 28 29 30

TyA TyC TyD ChA ChC ChD OsA OsB OsC2 HdA HdB HeC2 TrA TrB TrC2 BeA Bd Gf Mg Pa Mf Ad Tx Re GP AeA CoA Ma

INDIANA NO. 10

ST. JOSEPH COUNTY, INDIANA

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ST. JOSEPH COUNTY, INDIANA NO. 11

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Coordinate grid ticks and land division corners, if shown, are approximately controlled

12

N

1 Mile

5 000 Feet

0 0

¼ 1 000

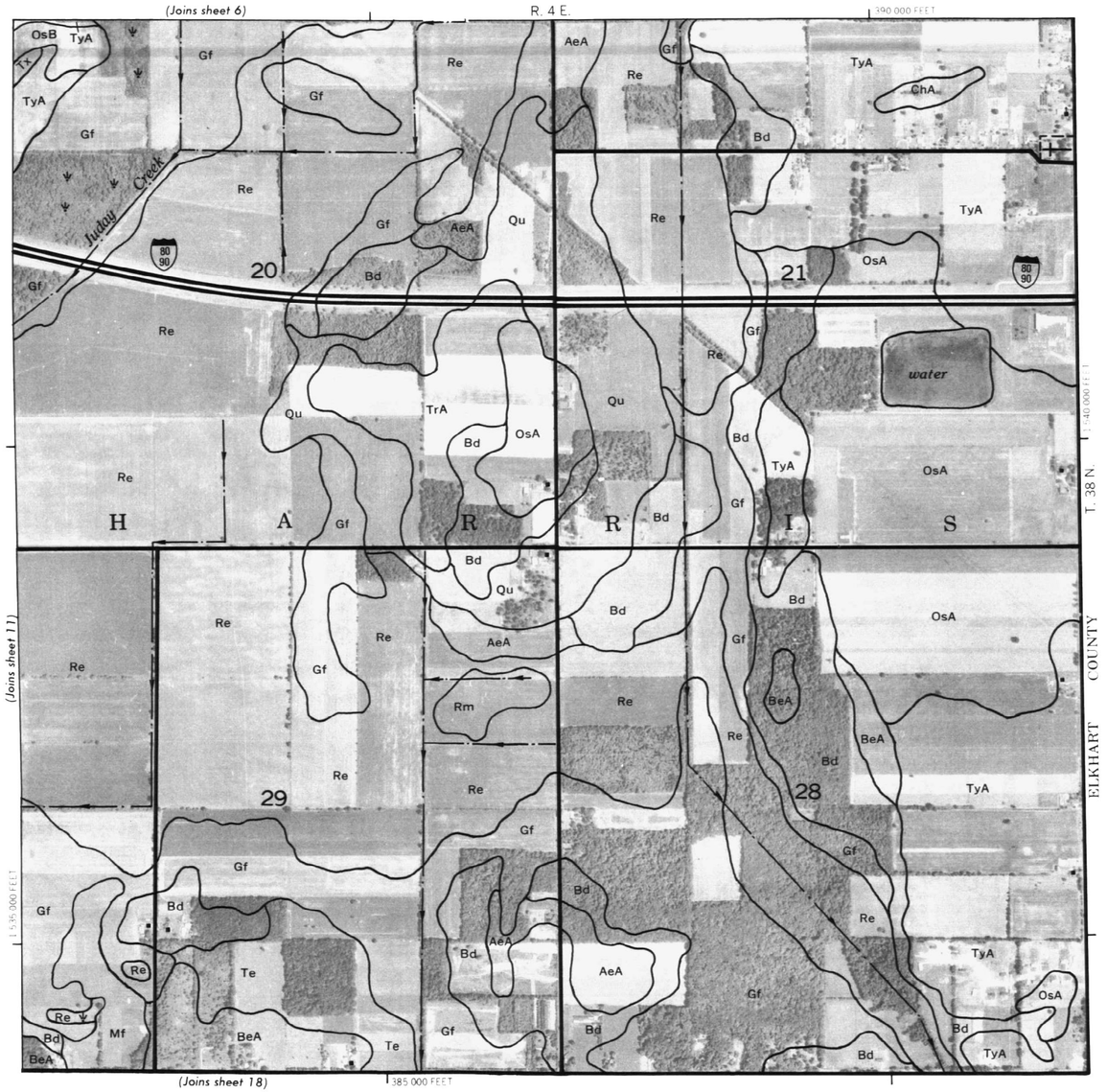
½ 2 000

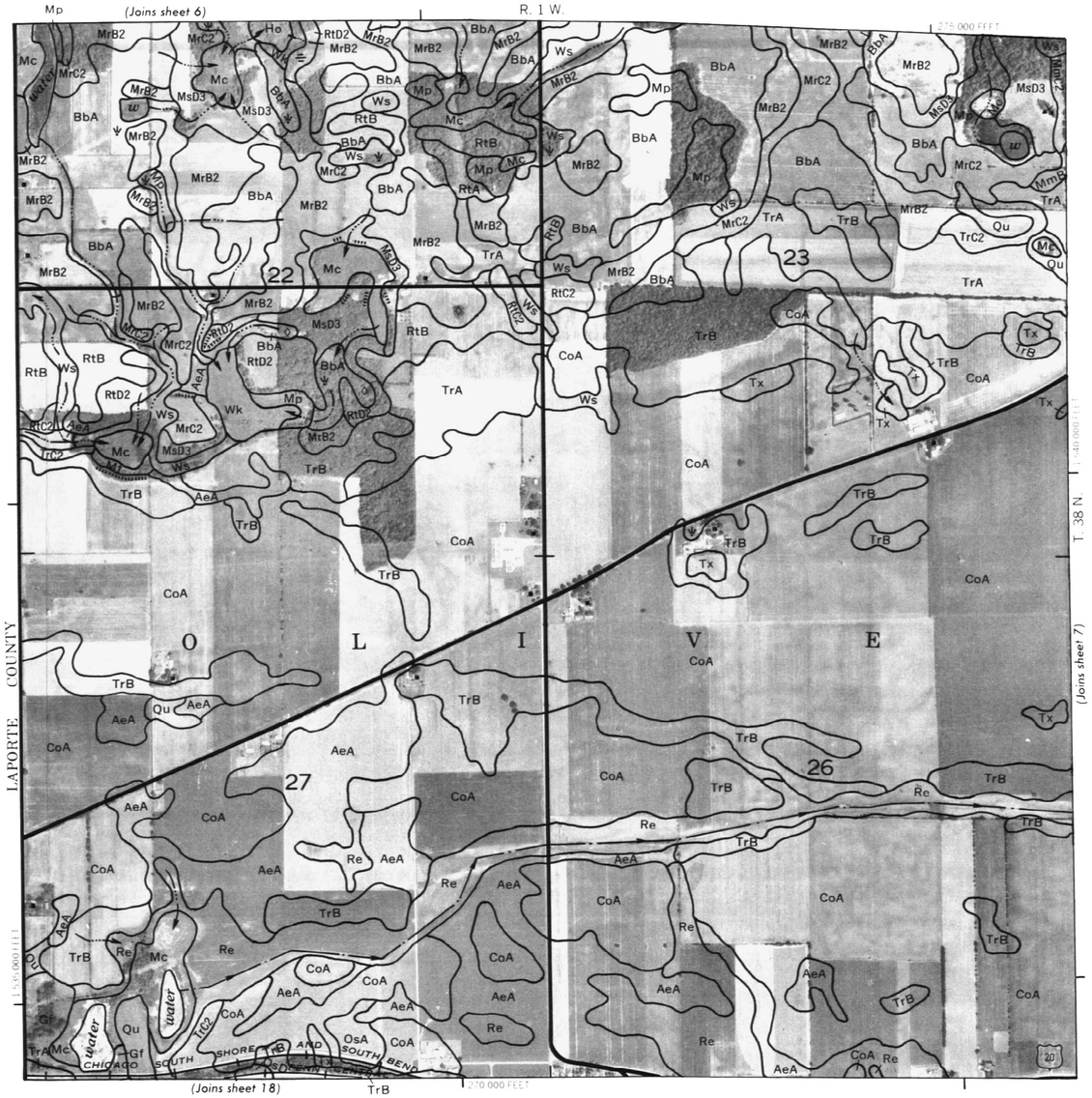
¾ 3 000

1 4 000

1 1/4 5 000

Scale 1:15 840





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Division corners, if shown, are approximately positioned
Coordinate grid ticks and land division corners, if shown, are approximately positioned

ST. JOSEPH COUNTY, INDIANA NO. 12

ST. JOSEPH COUNTY, INDIANA NO. 13

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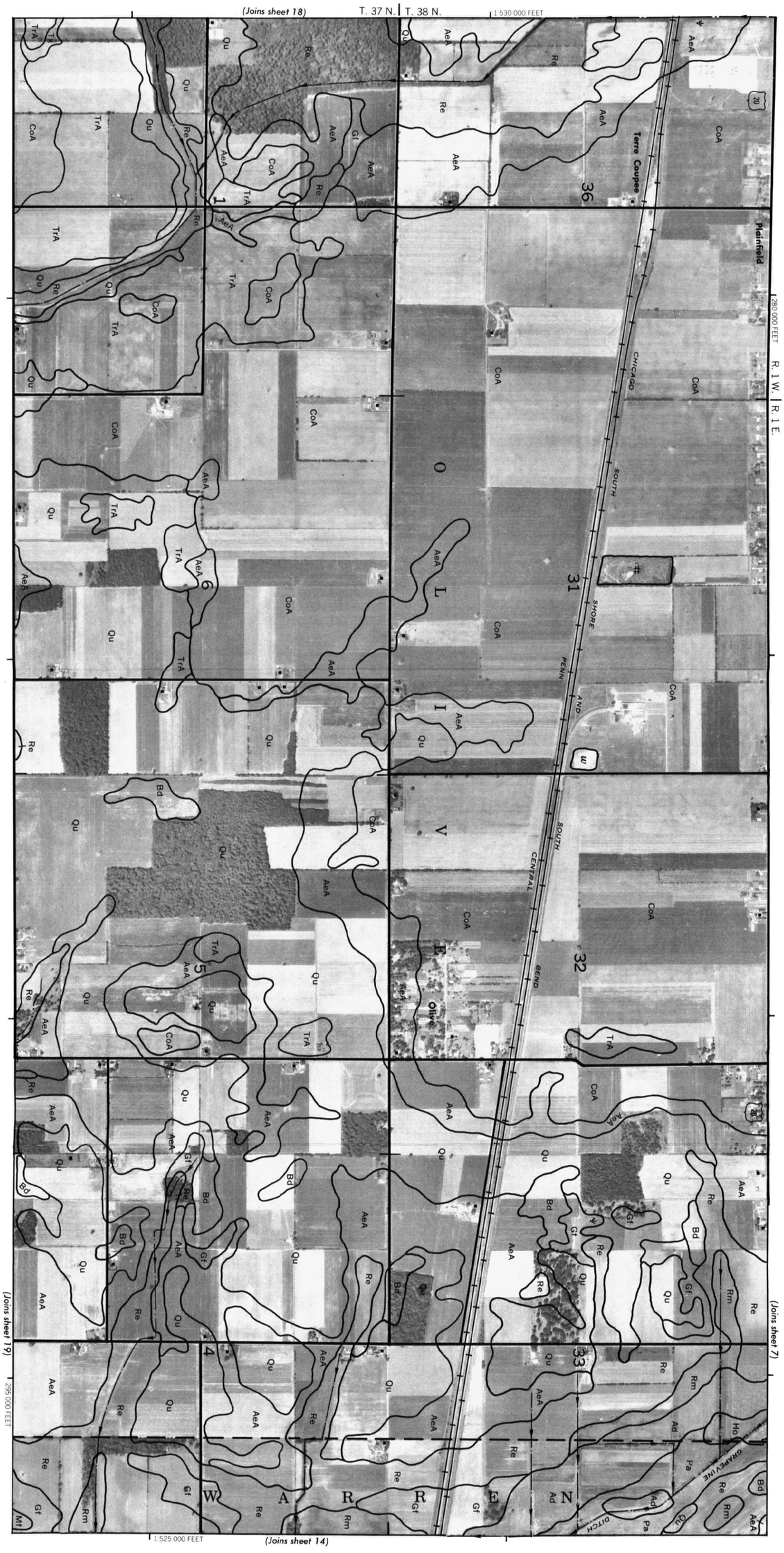

1 Mile
5 000 4 000 3 000 2 000 1 000 0 5 000 Feet
Scale 1:15 840

N

ST. JOSEPH COUNTY, INDIANA — SHEET NUMBER 13

ST. JOSEPH COUNTY, INDIANA — SHEET NUMBER 14

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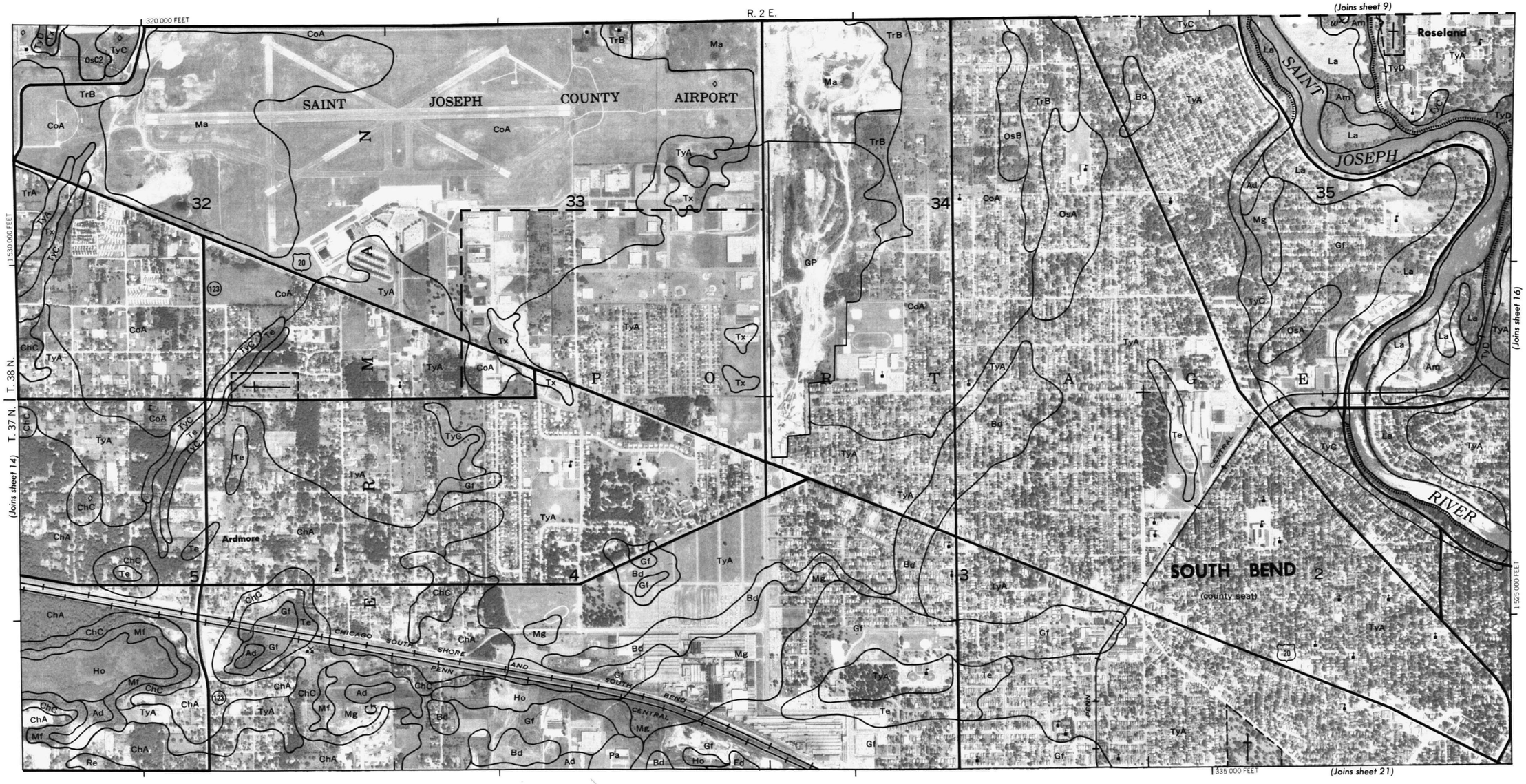
ST. JOSEPH COUNTY, INDIANA NO. 14



ST. JOSEPH COUNTY, INDIANA NO. 15

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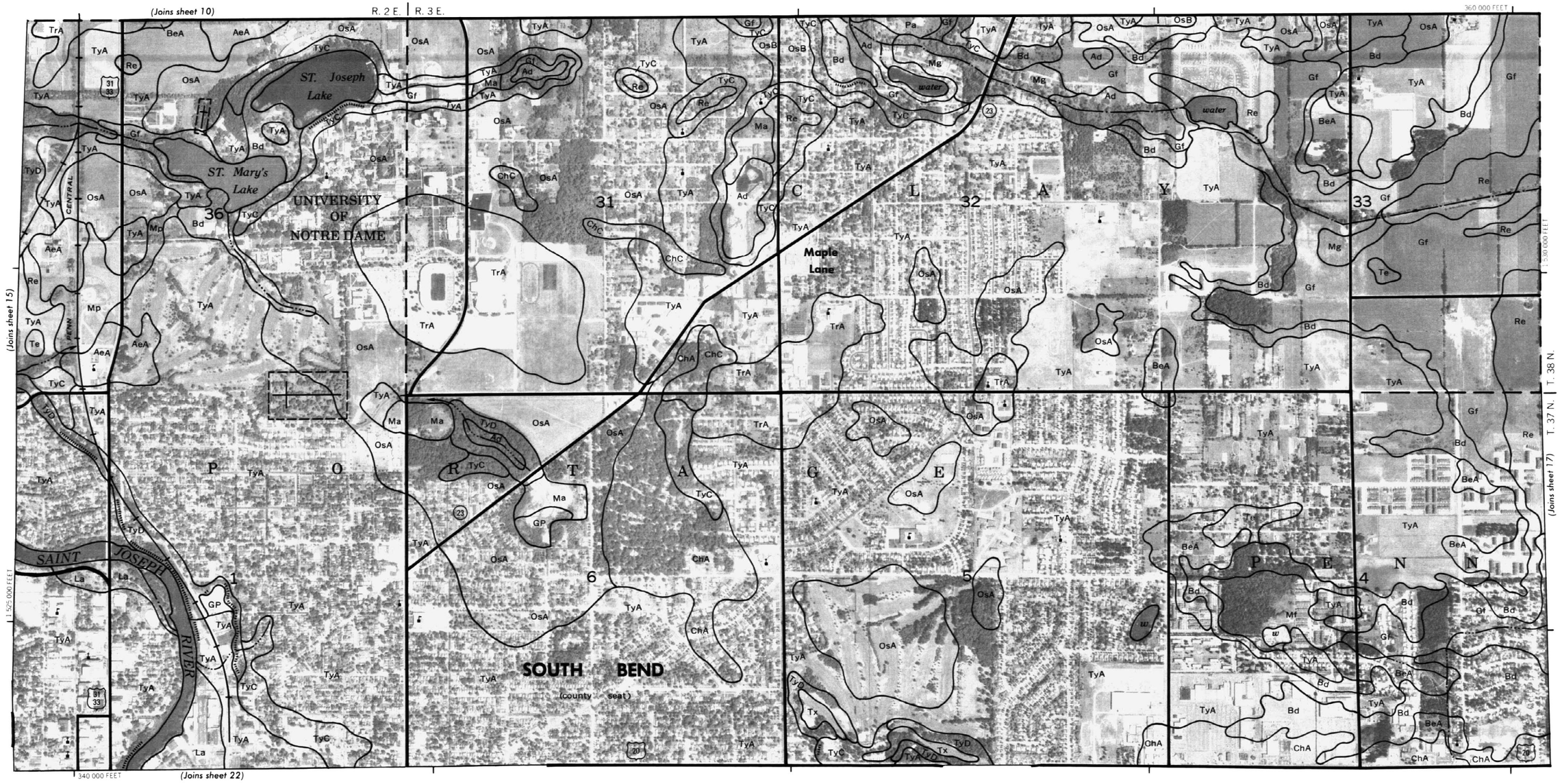

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ST. JOSEPH COUNTY, INDIANA NO. 17

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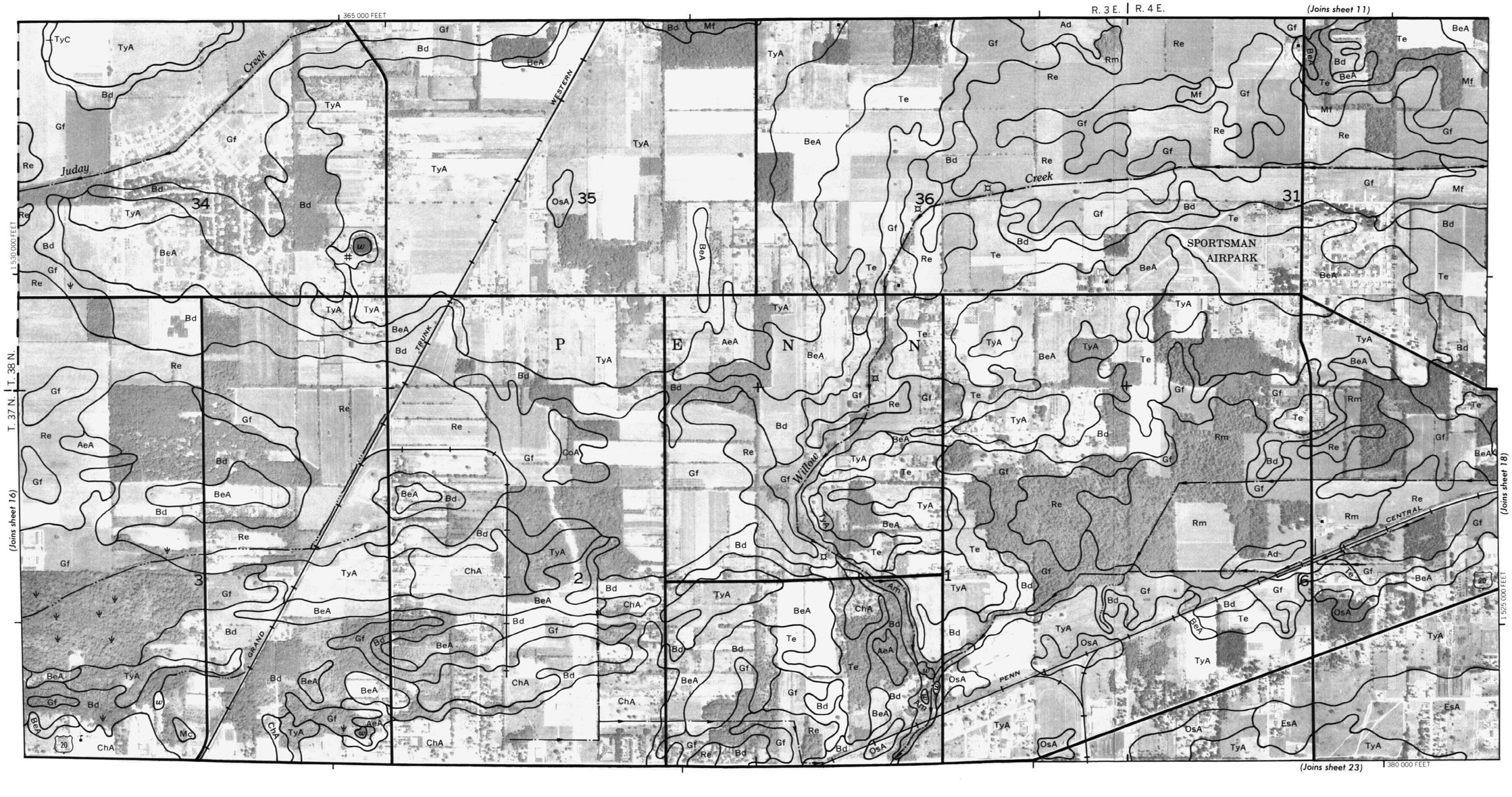
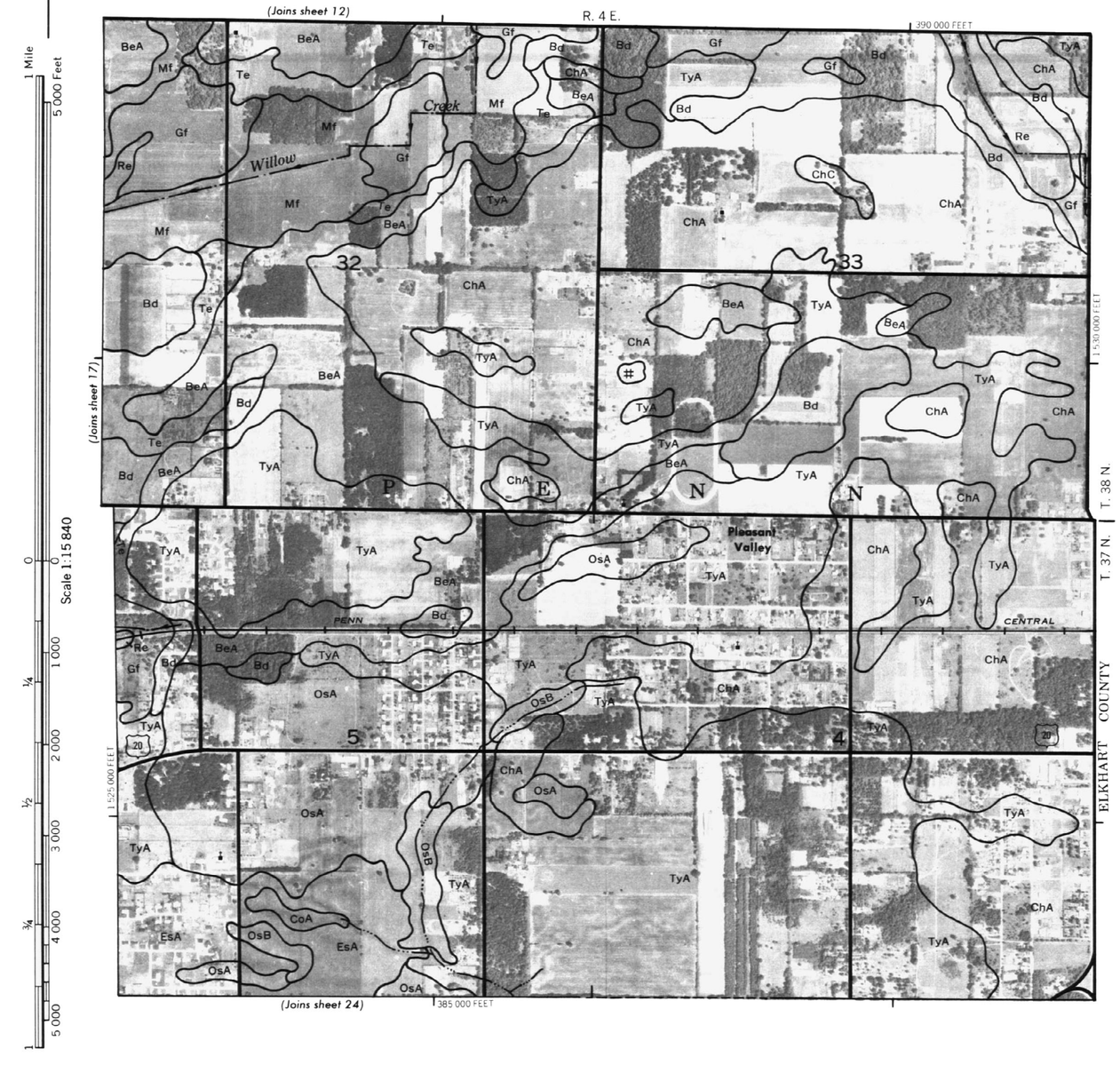
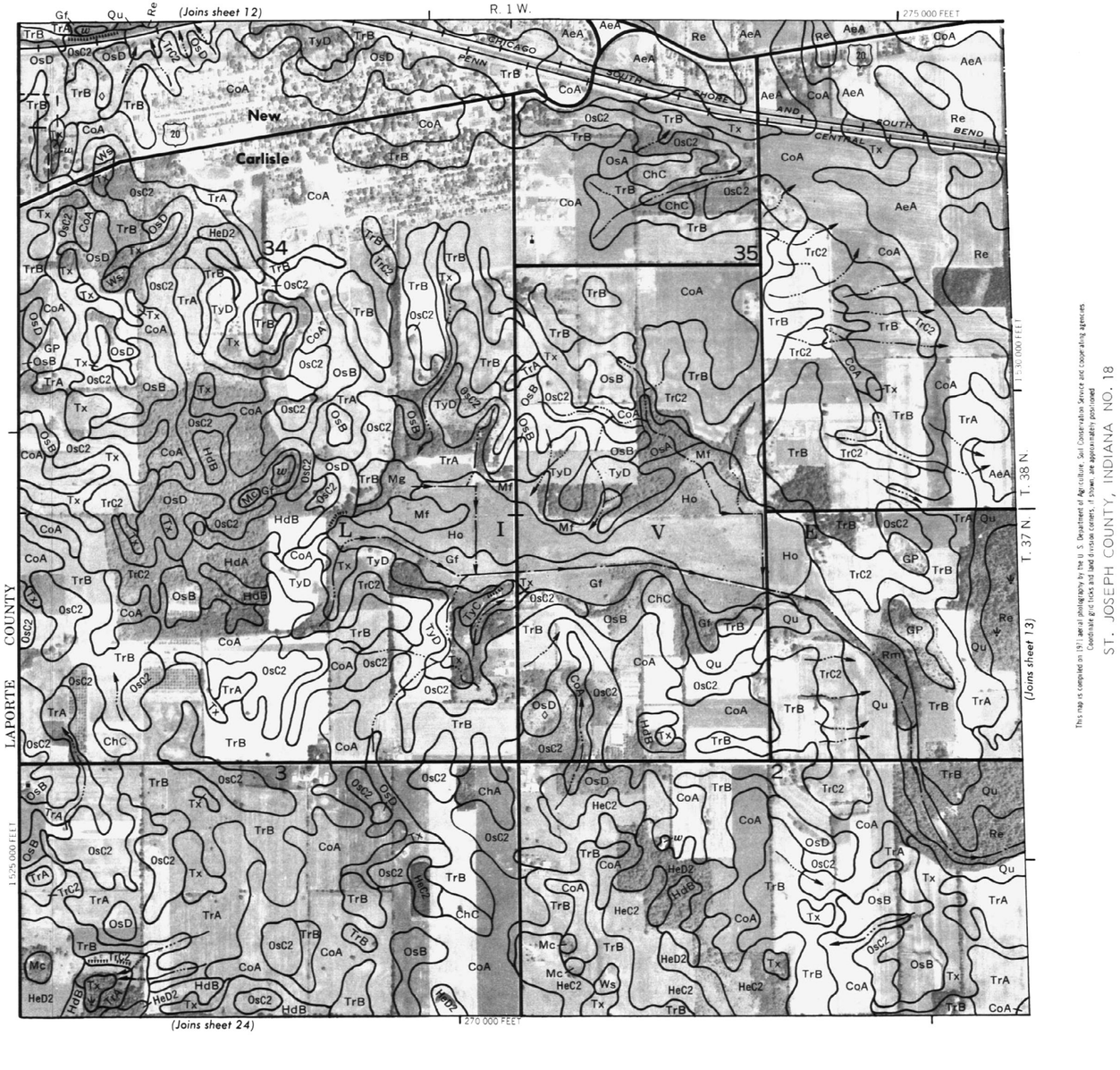


N

1 Mile
5 000 Feet
Scale 1:15 840





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Coordinate grid ticks and land division corners, if shown, are approximately positioned.

ST. JOSEPH COUNTY, INDIANA NO. 18

20

N

1 Mile

5 000 Feet

Scale 1:15 840

0 1/4 1/2 3/4 1

0 1 000 2 000 3 000 4 000 5 000

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ST. JOSEPH COUNTY, INDIANA NO. 20

ST. JOSEPH COUNTY, INDIANA NO. 21

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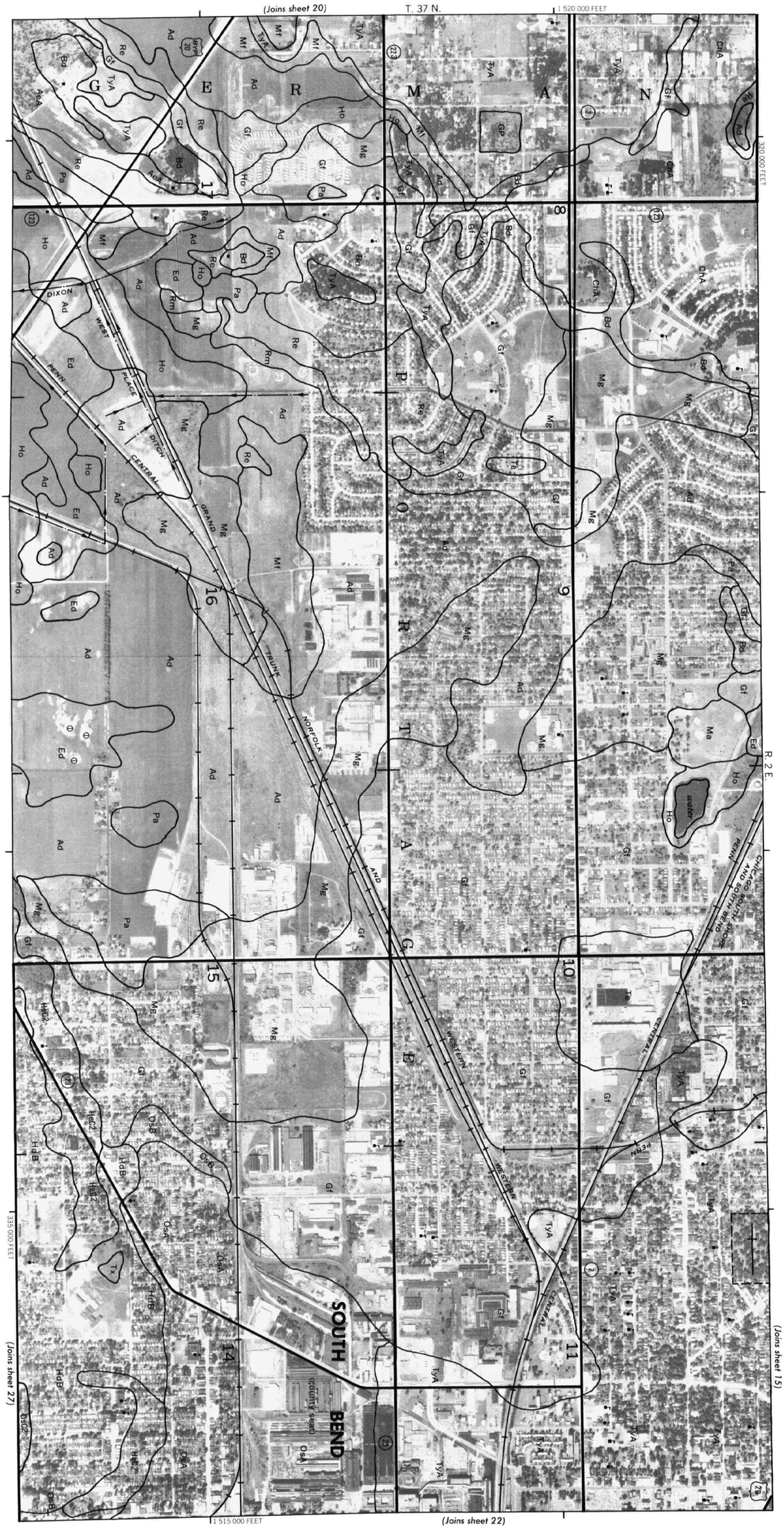
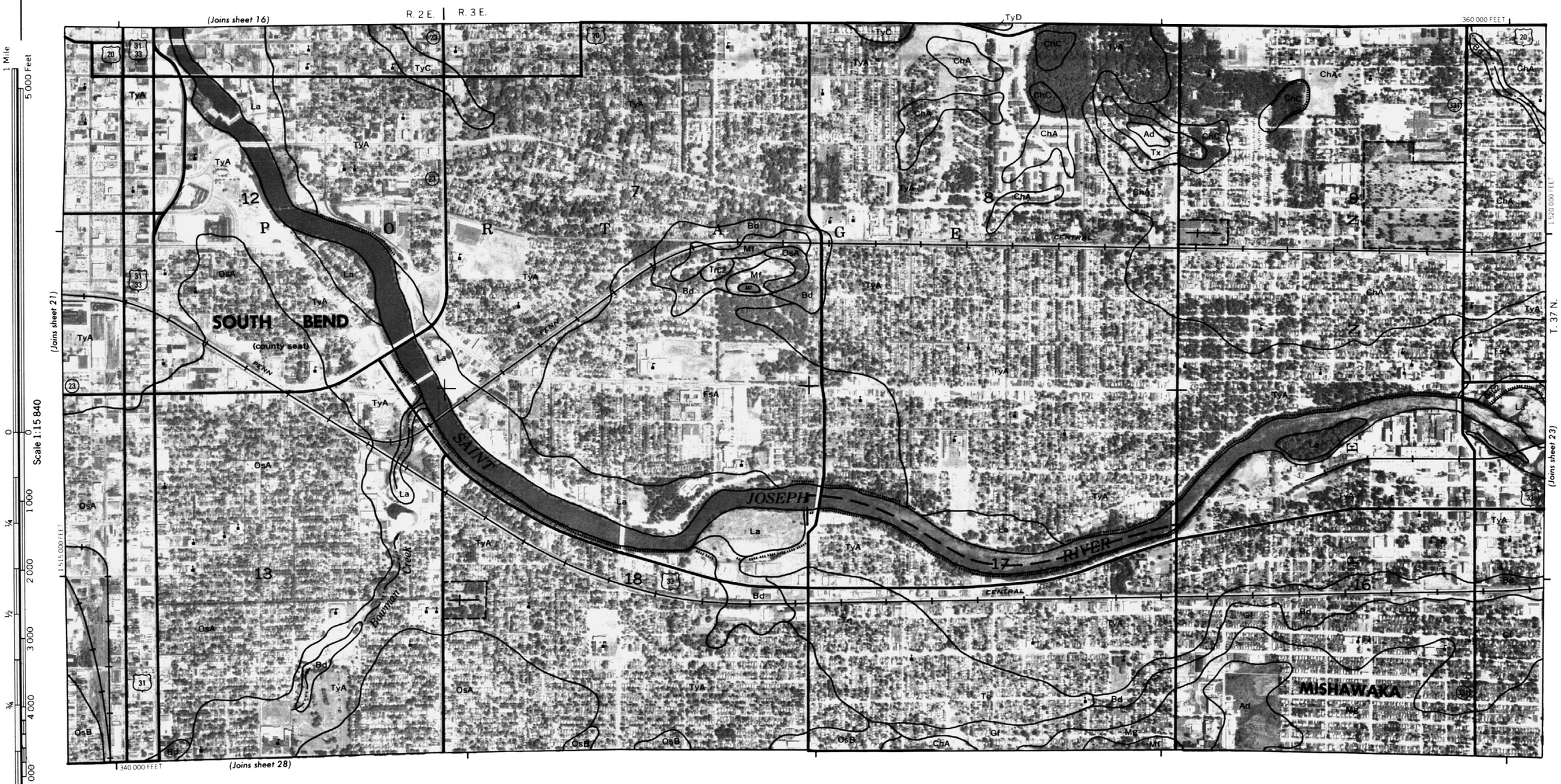


ST. JOSEPH COUNTY, INDIANA — SHEET NUMBER 21

1 ¾ ½ ¼ 0 1 Mile
5 000 4 000 3 000 2 000 1 000 0 5 000 Feet
Scale 1:15 840

N

21

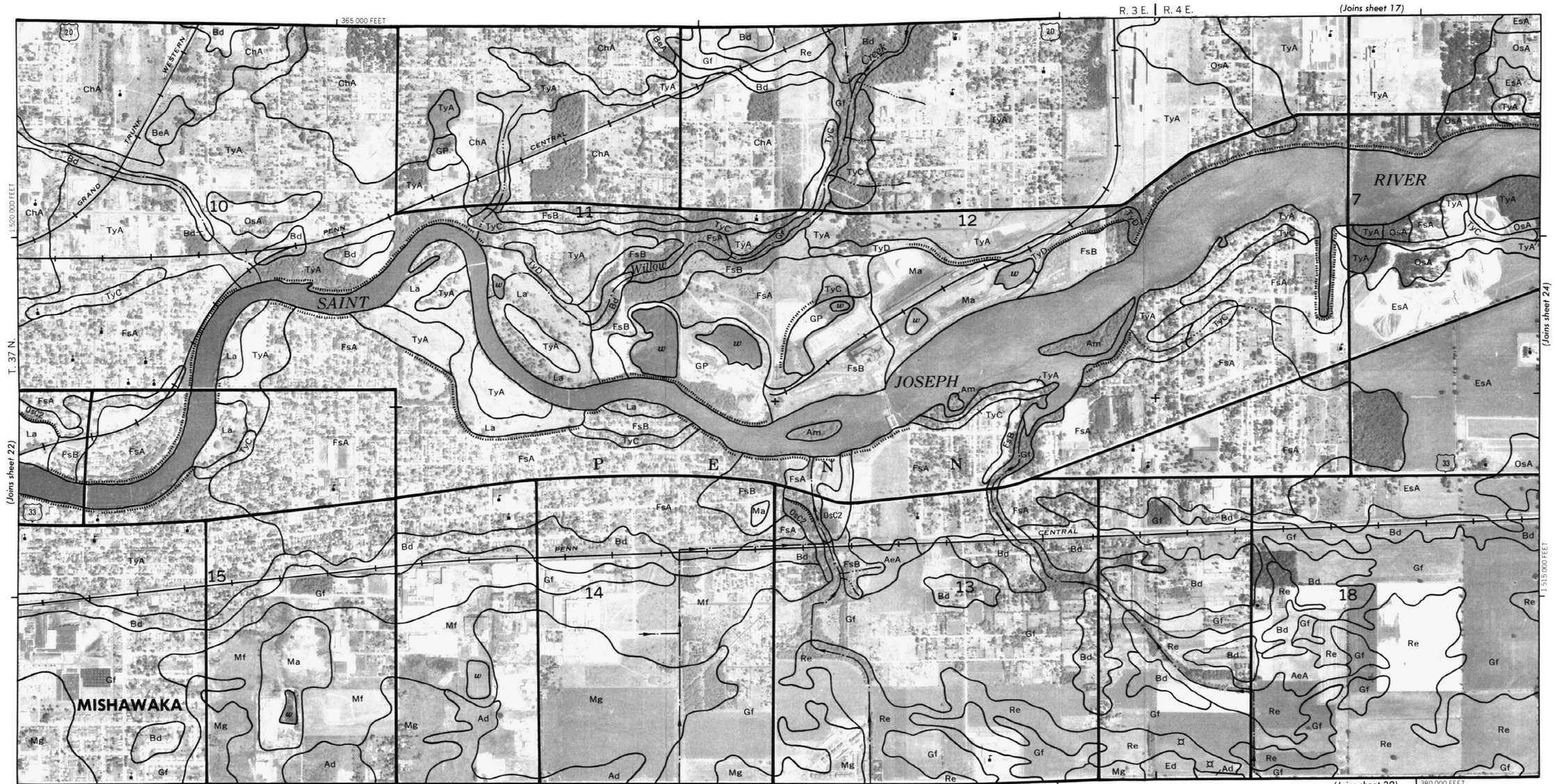


This map is compiled on 1971 aerial photographs by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

ST. JOSEPH COUNTY, INDIANA NO. 22

ST. JOSEPH COUNTY, INDIANA NO. 23

This map is compiled on 1971 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned



23

N

1 Mile

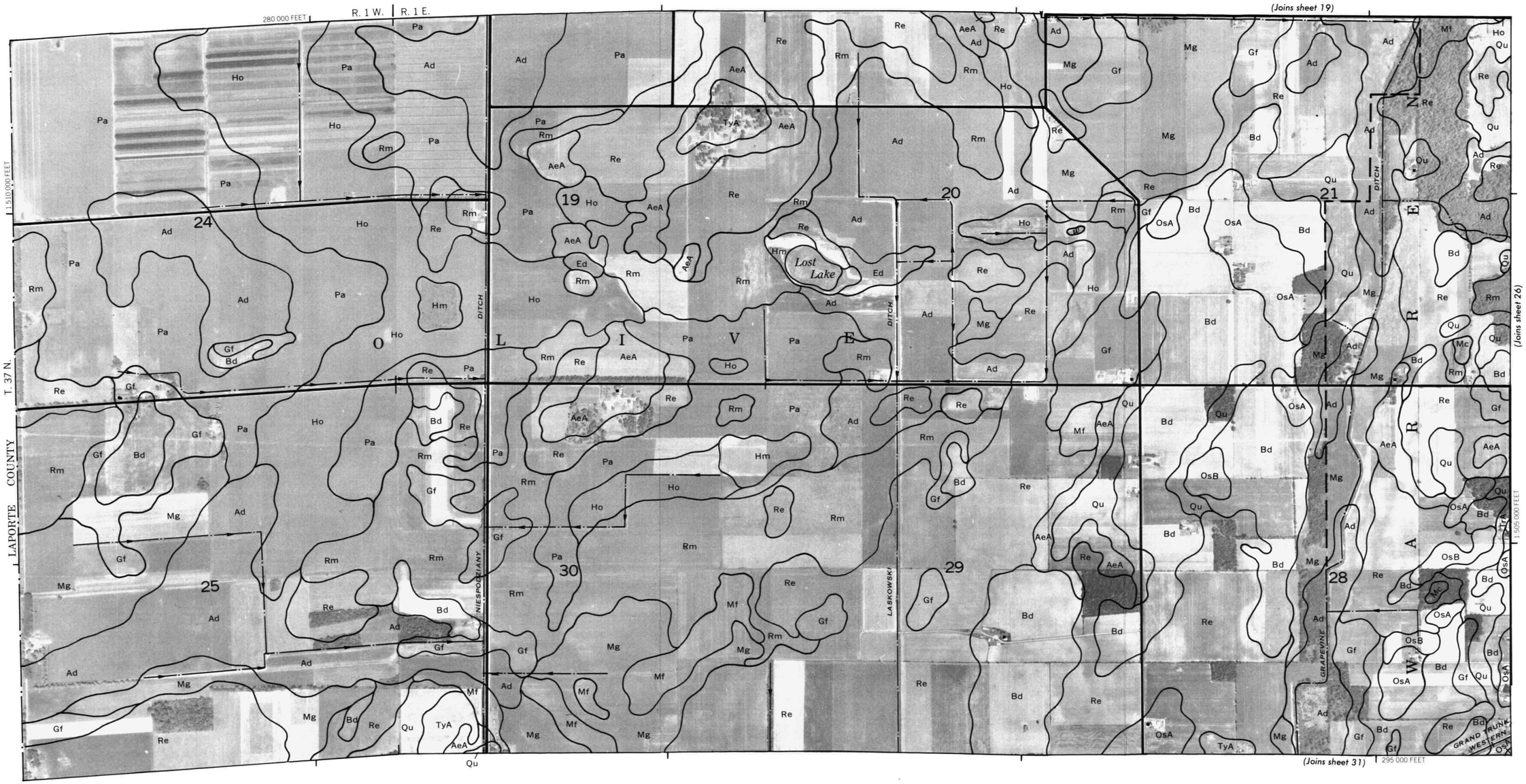
5 000 Feet

Scale 1:15 840

0 1/4 1/2 3/4 1

1 000 2 000 3 000 4 000 5 000

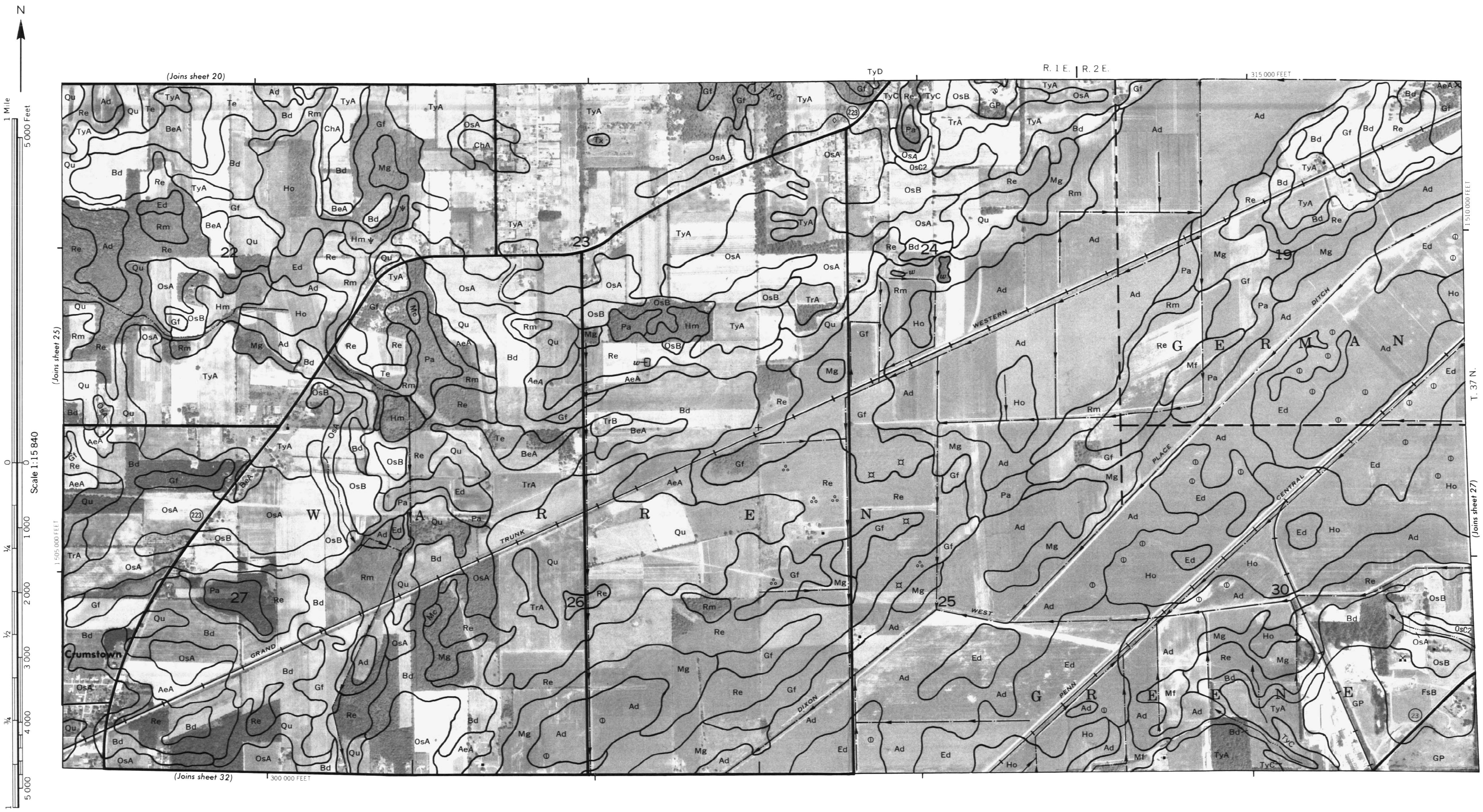

24
N
1 Mile
5 000 Feet
Scale 1:15 840
(Joins sheet 18)
R. 4 E.
390 000 FEET
(Joins sheet 23)
SAINT JOSEPH RIVER
Baugo Bay
PENN
CENTRAL
Osceola
ELKHART COUNTY
T. 37 N.
1 520 000 FEET
1 515 000 FEET
(Joins sheet 30)
385 000 FEET
(Joins sheet 18)
R. 1 W.
275 000 FEET
LAPORTE COUNTY
BENDIX WOODS PARK
PROVING GROUNDS
(Joins sheet 19)
270 000 FEET
LAPORTE COUNTY
T. 37 N.
1 520 000 FEET
This map is compiled on 1971 aerial photography by the U. S. Department of Agriculture Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.
ST. JOSEPH COUNTY, INDIANA NO. 24



ST. JOSEPH COUNTY, INDIANA NO. 25

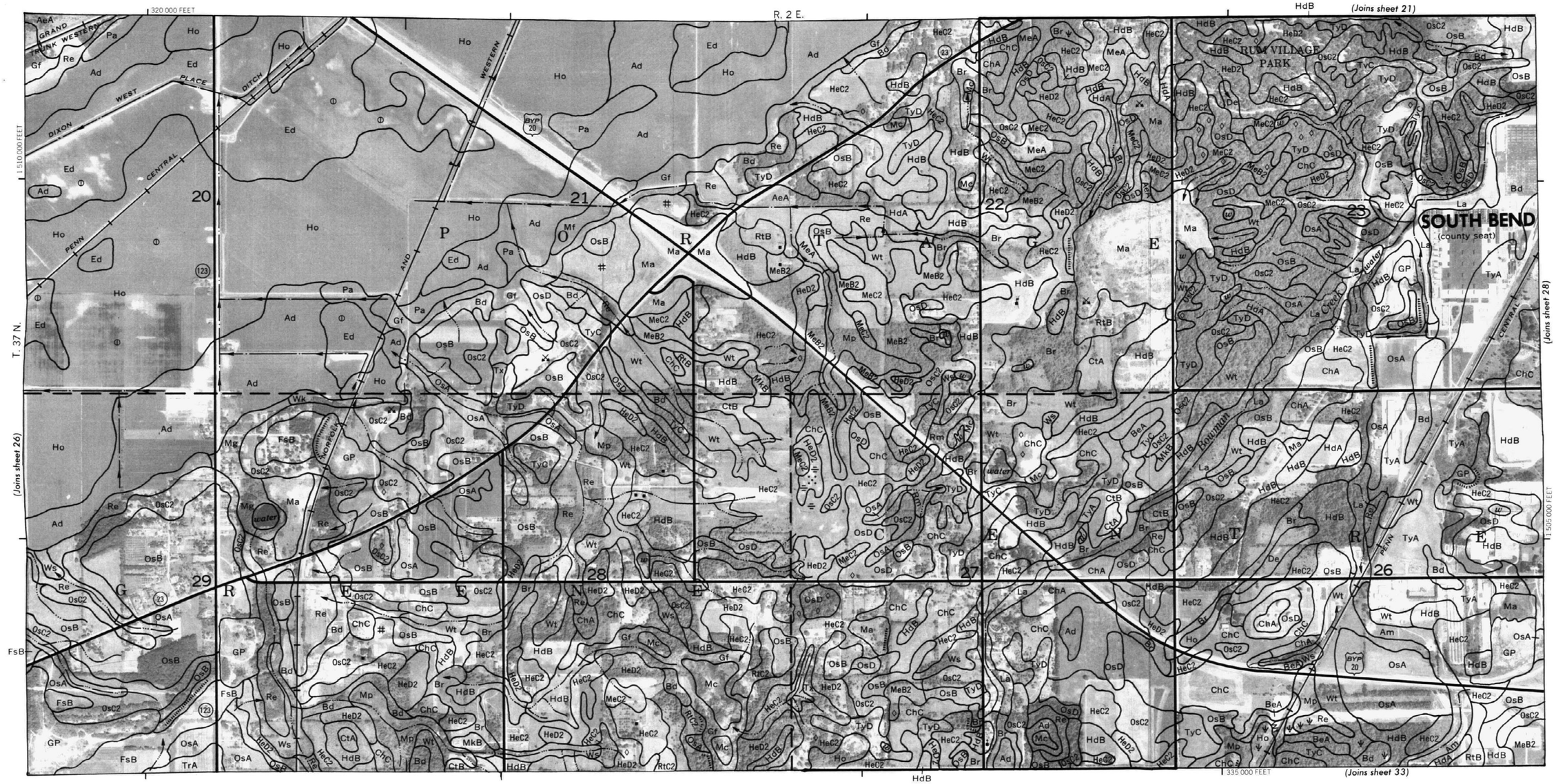
This map is compiled on 1971 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned

26



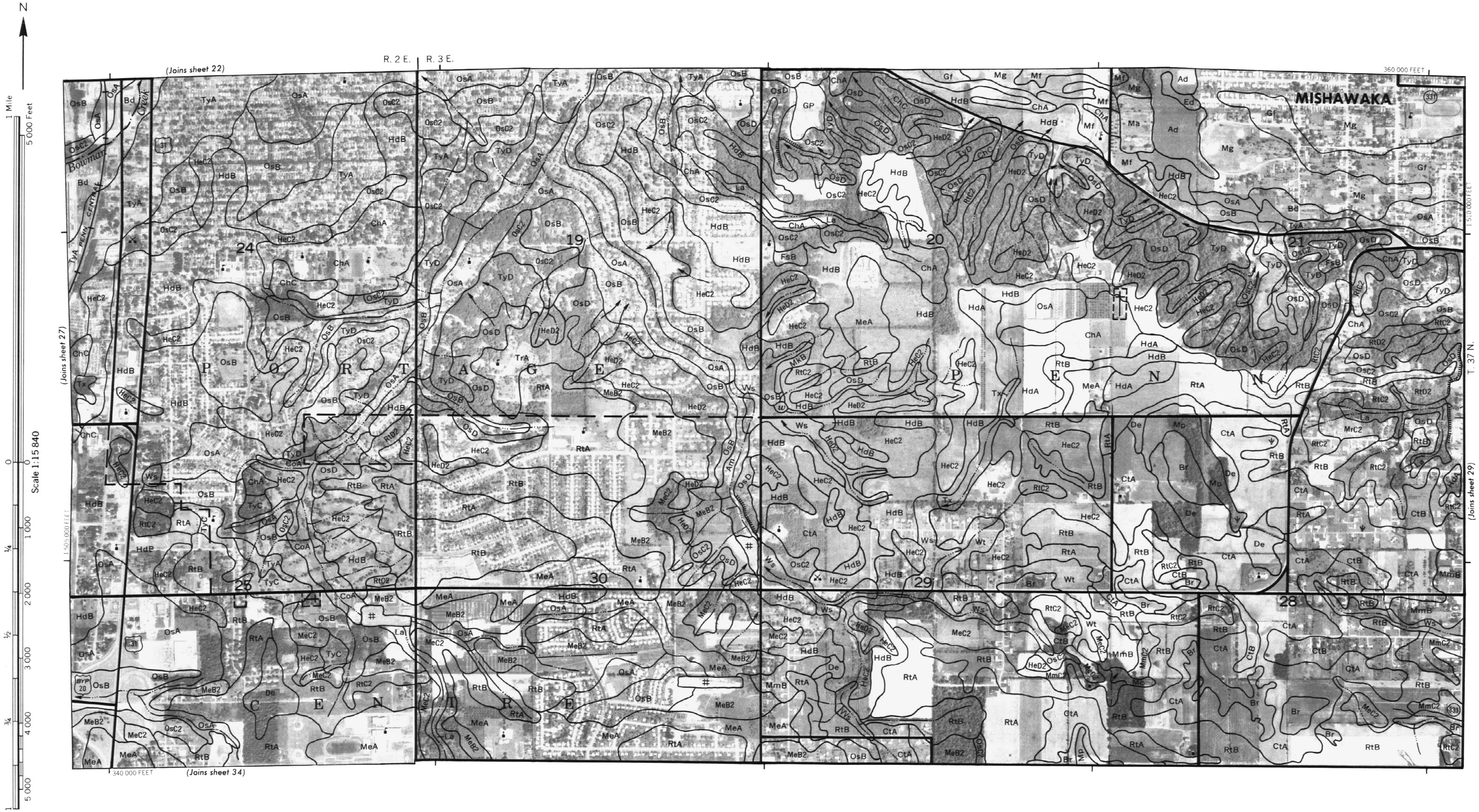
This map is compiled on 1971 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned

ST. JOSEPH COUNTY, INDIANA NO. 26



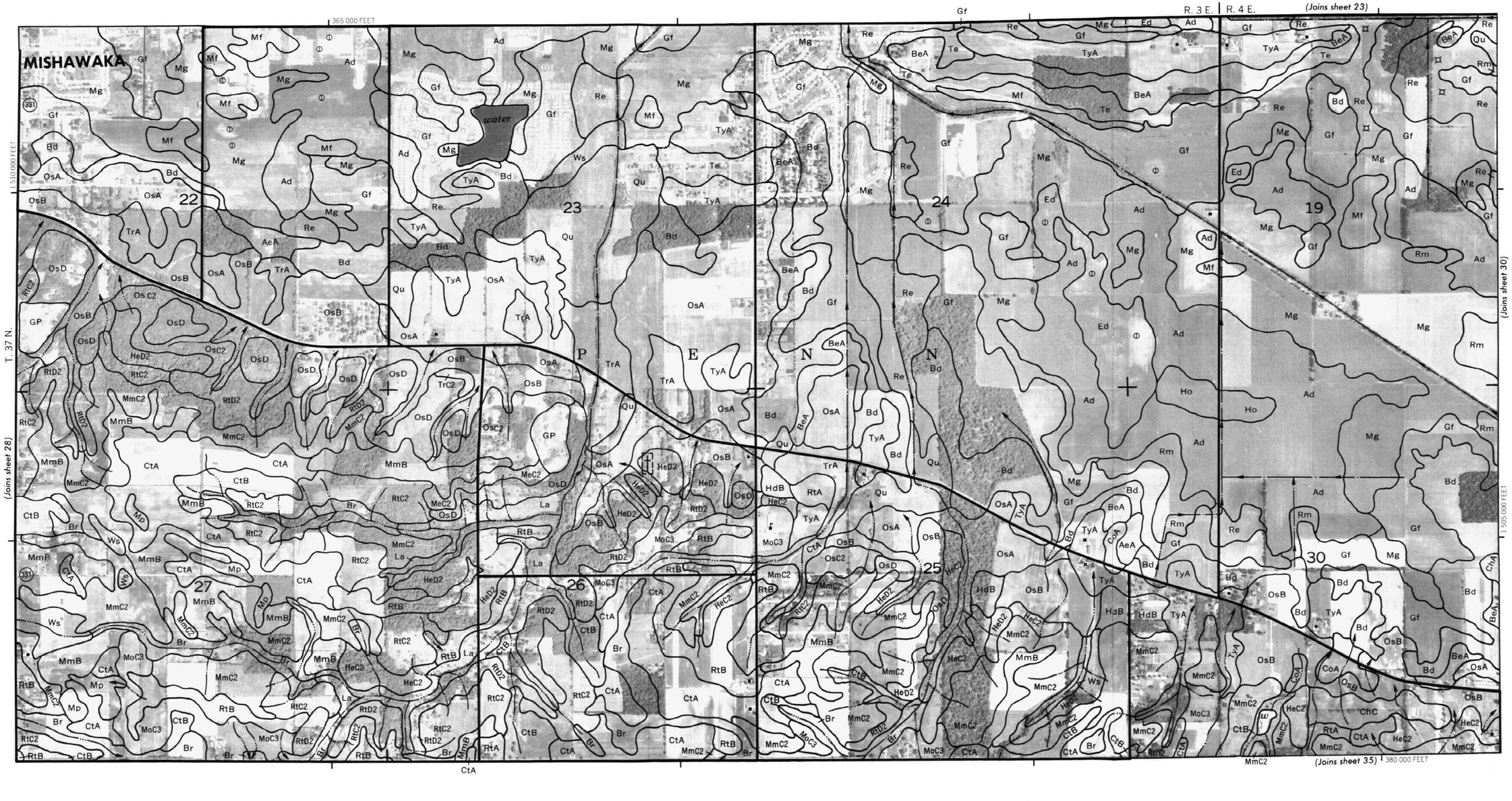
ST. JOSEPH COUNTY, INDIANA NO. 27

This map is compiled on 1951 aerial photography by the U. S. Department of Agriculture. Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned



This map is compiled on 1971 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

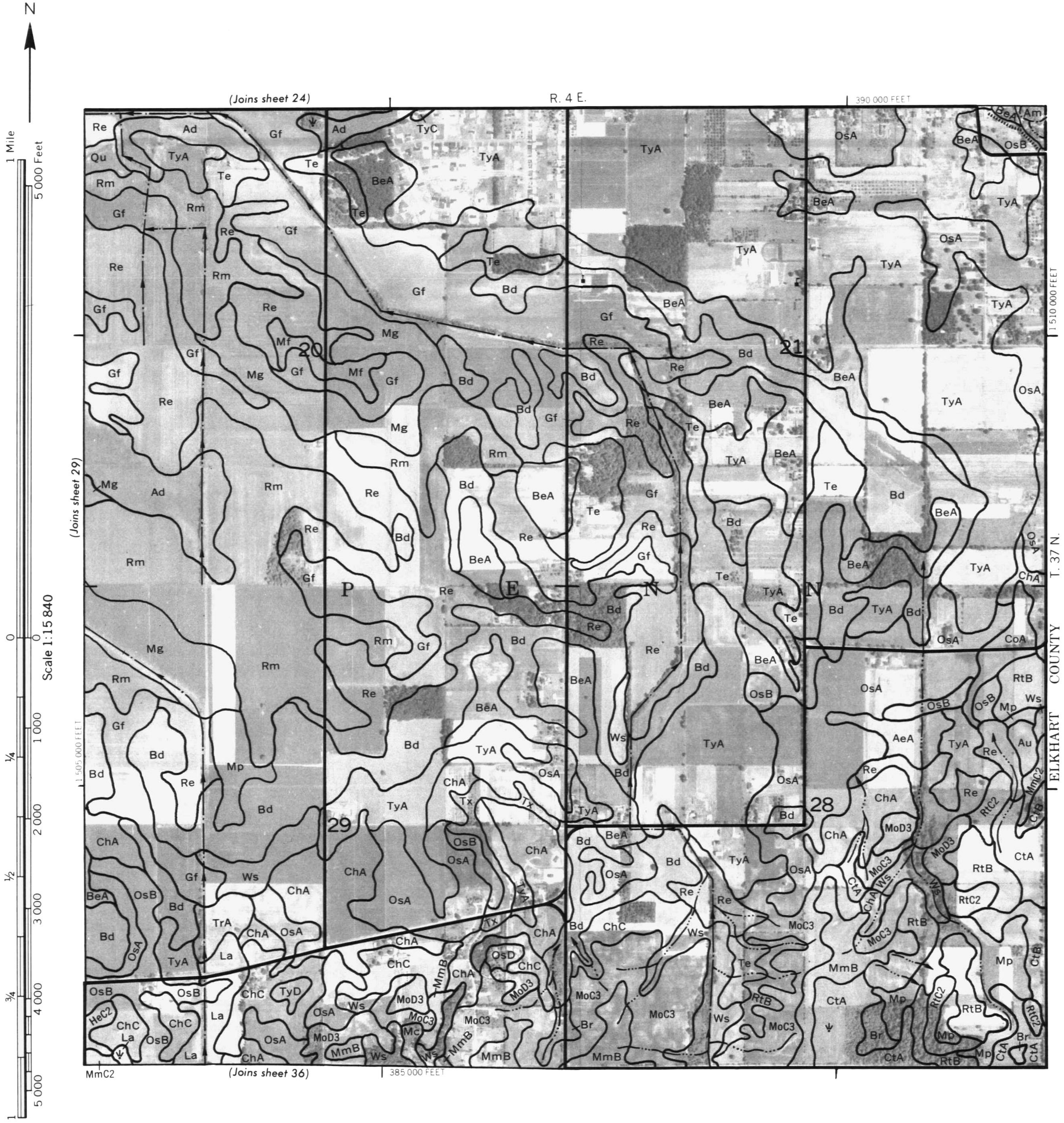
ST. JOSEPH COUNTY, INDIANA NO. 28



ST. JOSEPH COUNTY, INDIANA NO. 29

This map is compiled on 1951 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

30



This map is compiled on 1971 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned

ST. JOSEPH COUNTY, INDIANA NO. 30

ST. JOSEPH COUNTY, INDIANA NO. 31

This map is compiled on 1971 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

31

N

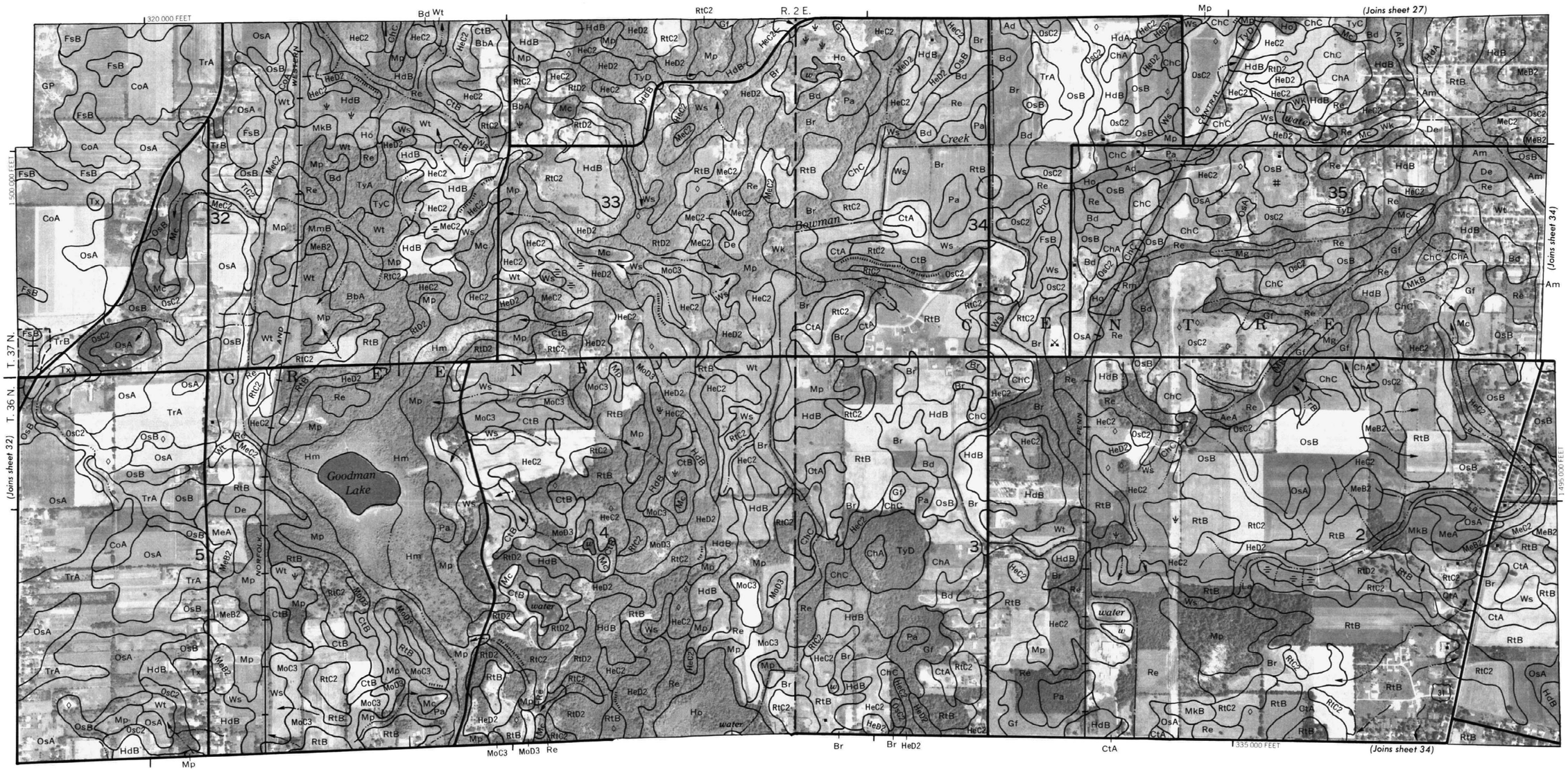
1 Mile

5 000 Feet

Scale 1:15 840

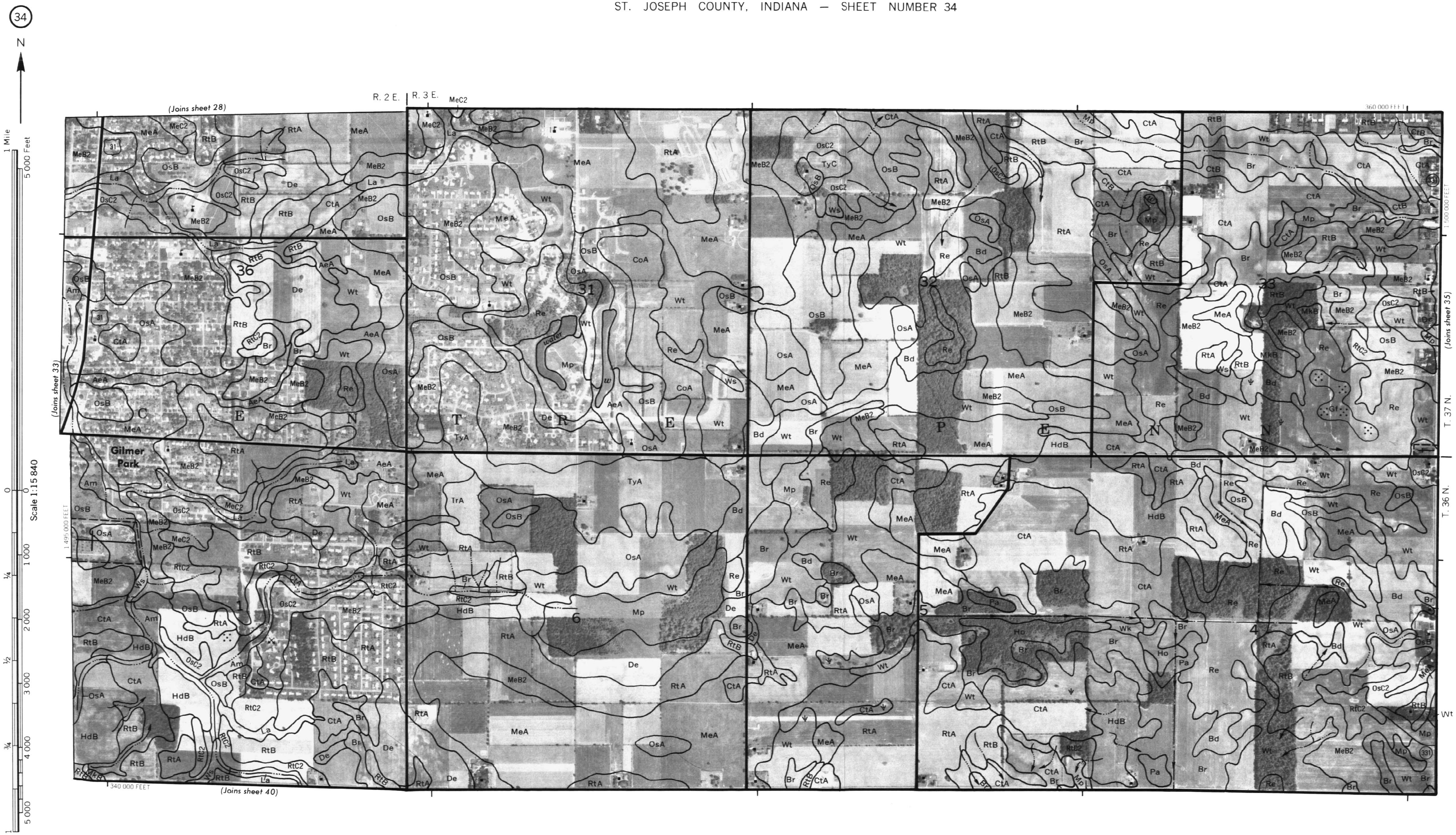
This map is compiled on 1971 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies
Coordinate grid lines and land division corners, if shown, are approximately positioned

ST. JOSEPH COUNTY, INDIANA NO. 32



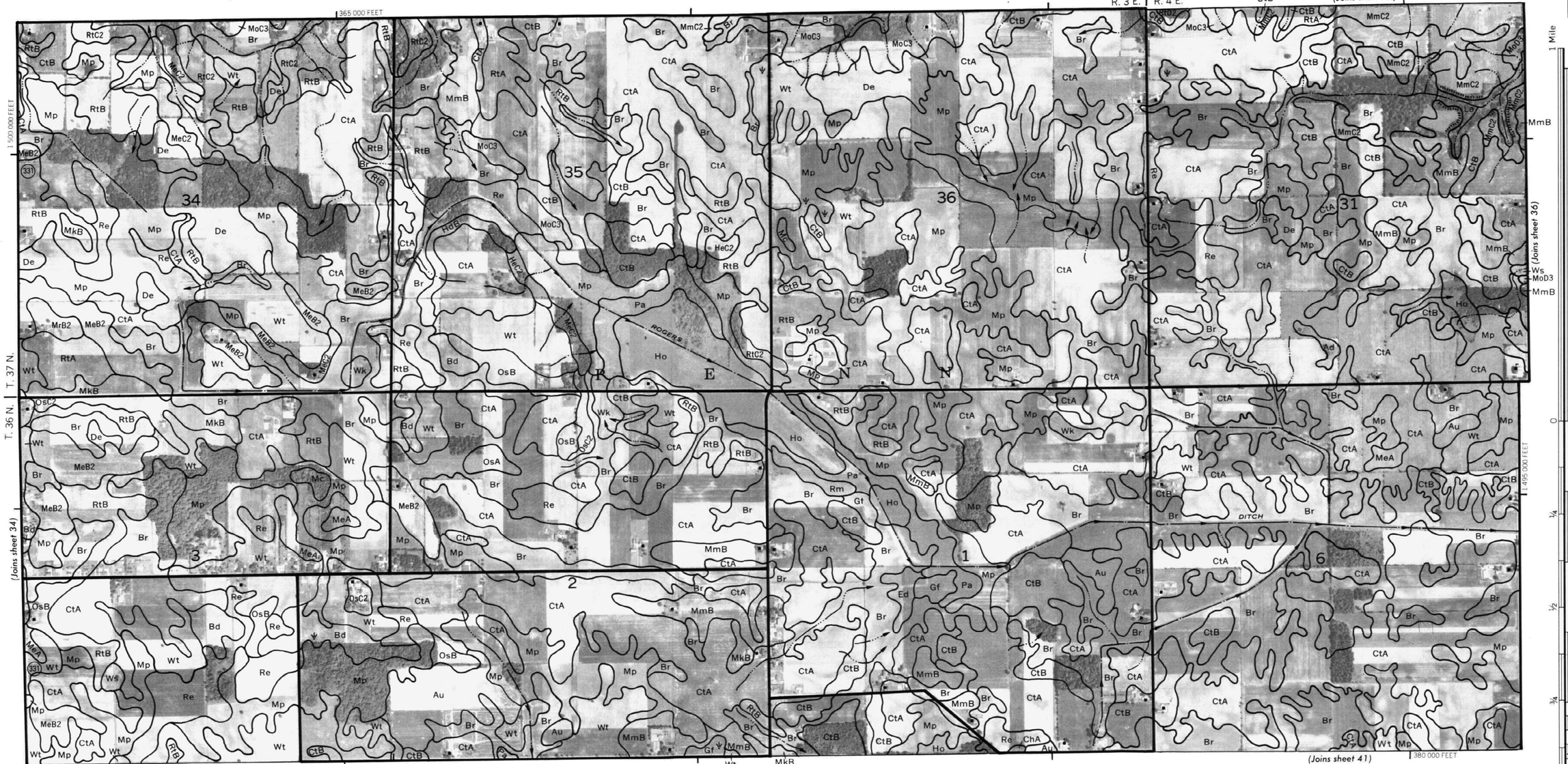
ST. JOSEPH COUNTY, INDIANA NO. 33

This map is compiled on 1971 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned



This map is compiled on 1971 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies
Coordinate grid ticks and land division corners, if shown, are approximately positioned

ST. JOSEPH COUNTY, INDIANA NO. 34



ST. JOSEPH COUNTY, INDIANA NO. 35

This map is compiled on 1971 aerial photography by the U. S. Department of Agriculture. Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned

N

1 Mile

5 000 Feet

0 0

Scale 1:15 840

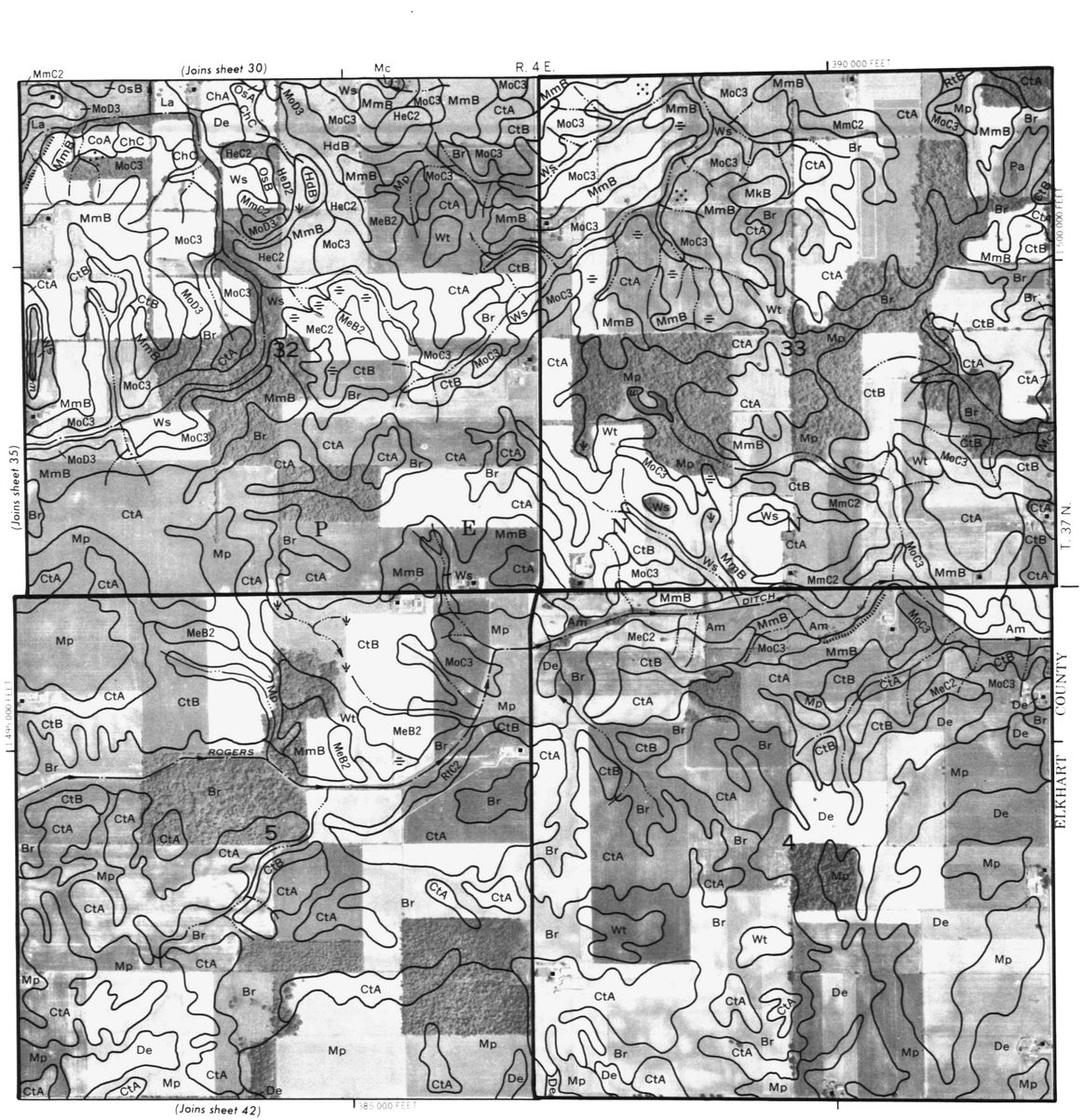
¼ 1 000

2 000

½ 3 000

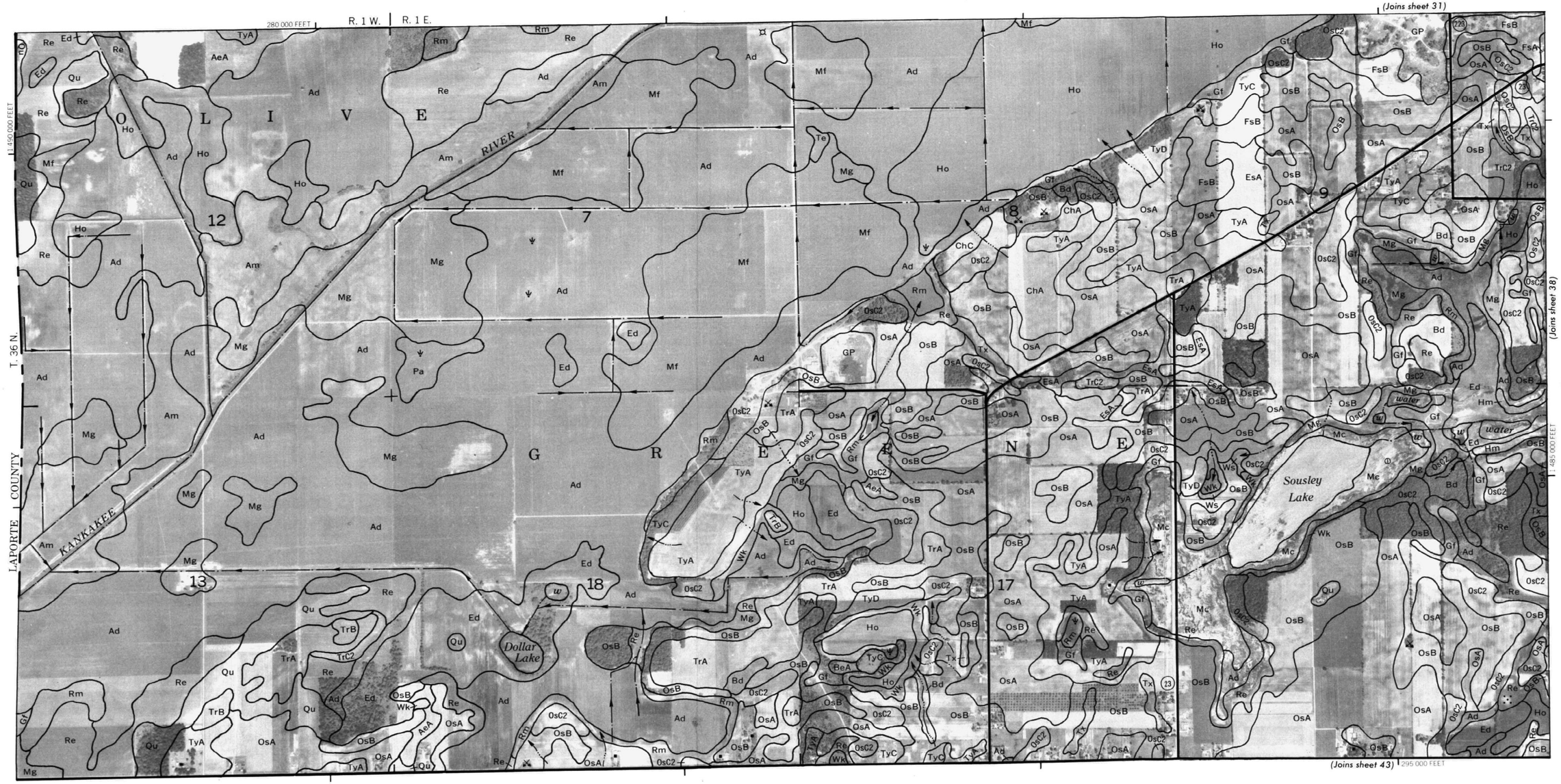
¾ 4 000

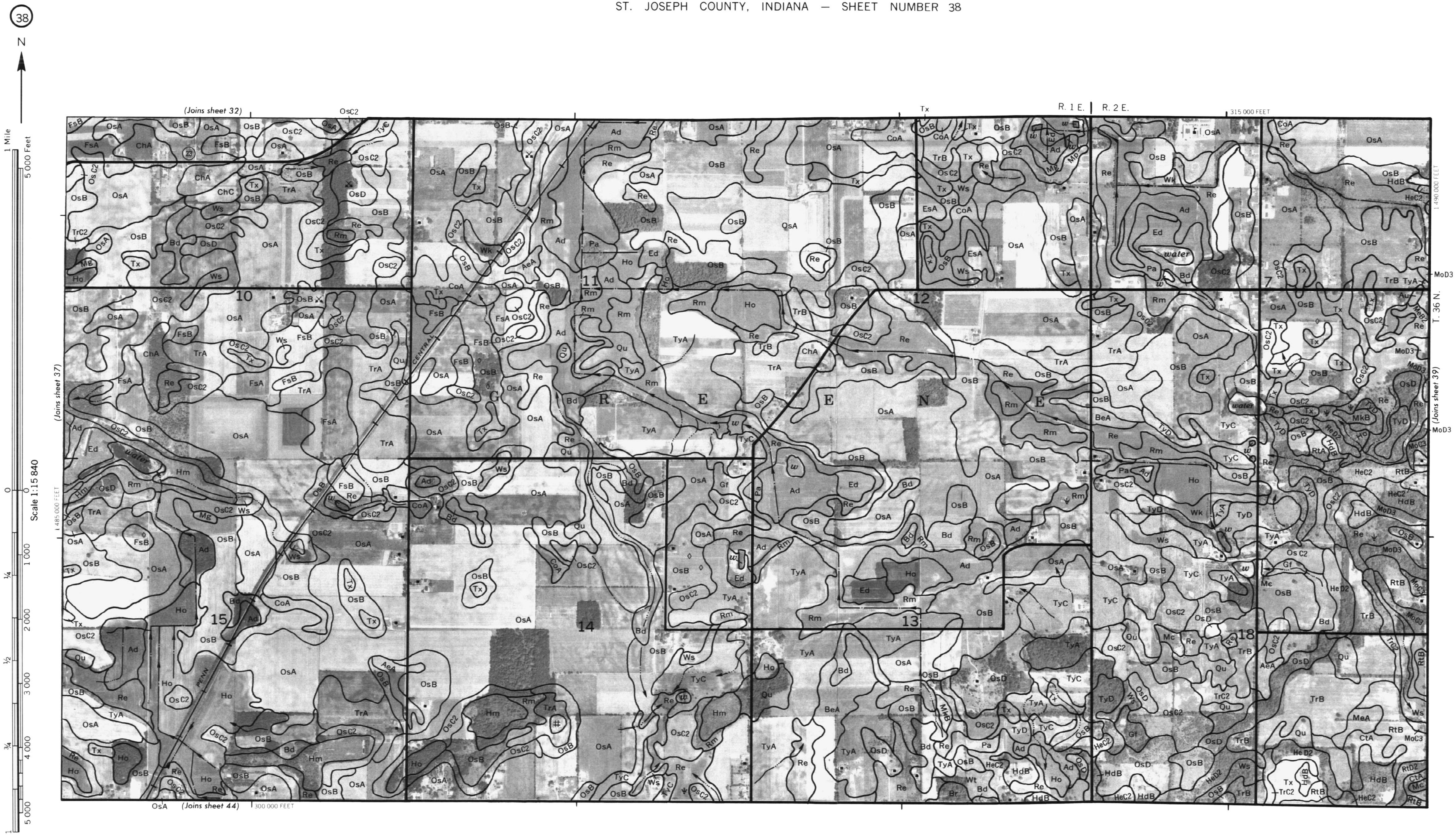
1 5 000



This map is compiled on 1971 aerial photography by the U. S. Department of Agriculture. Soil conservation districts and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned

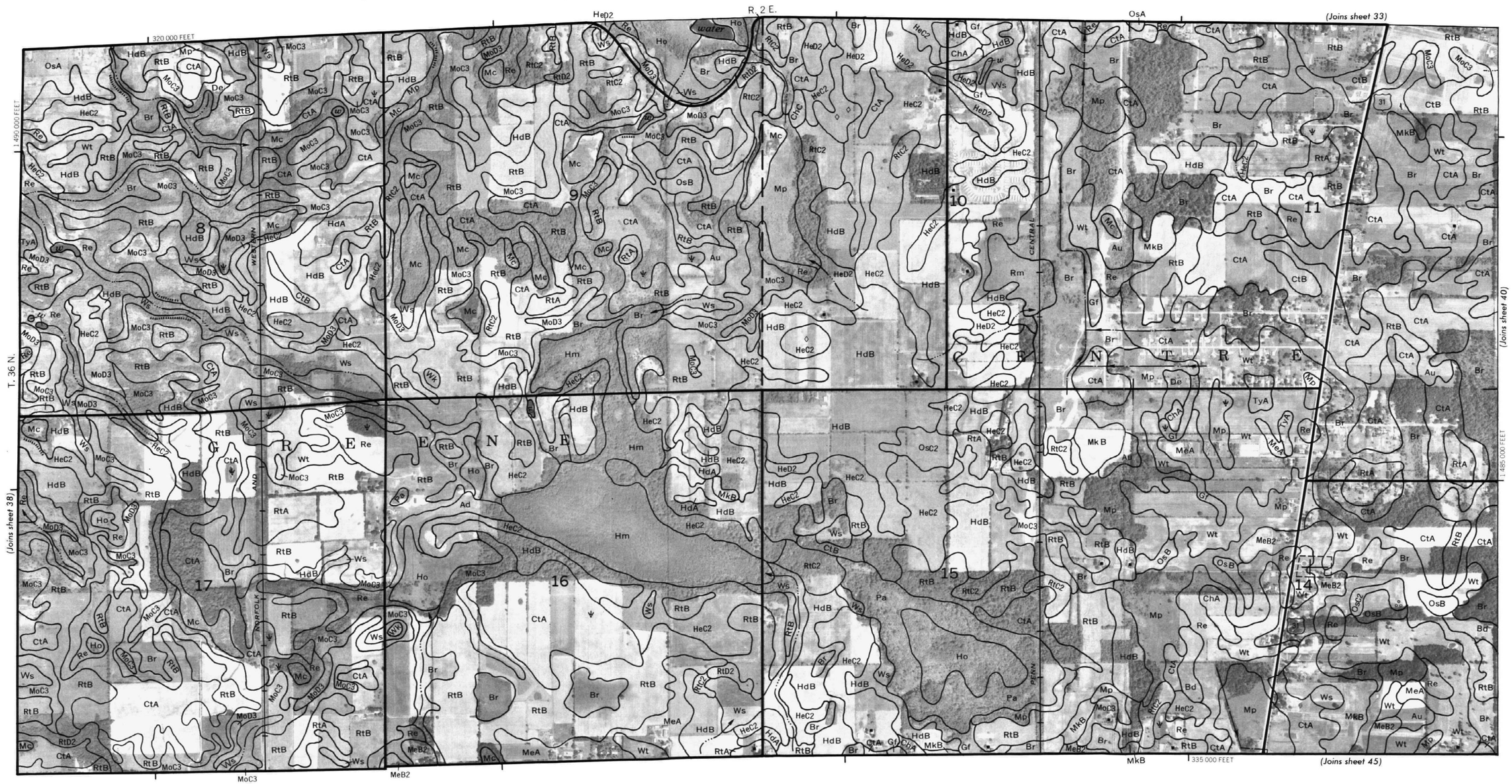
ST. JOSEPH COUNTY, INDIANA NO. 36





This map is compiled on 1971 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned

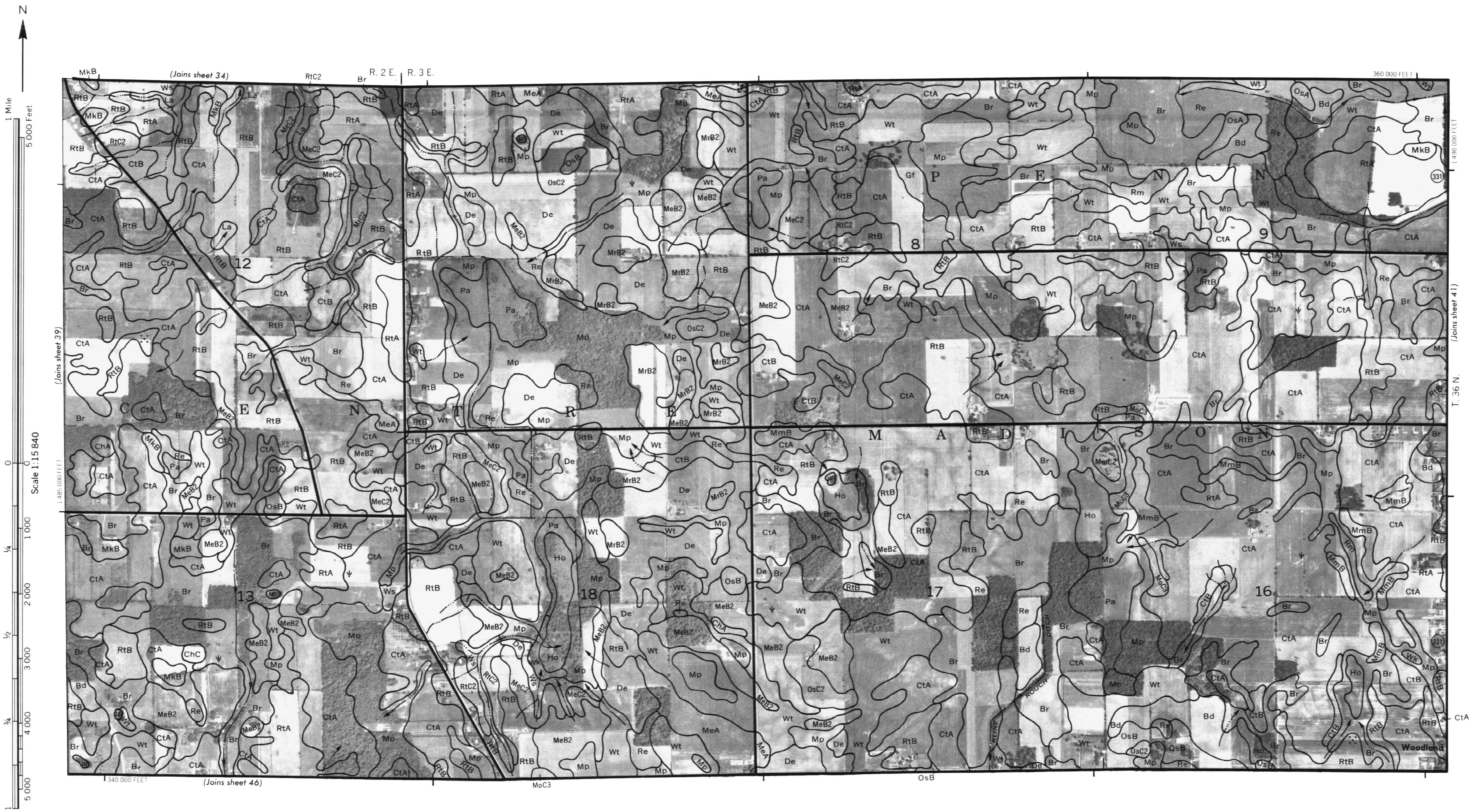
ST. JOSEPH COUNTY, INDIANA NO. 38



ST. JOSEPH COUNTY, INDIANA NO. 39

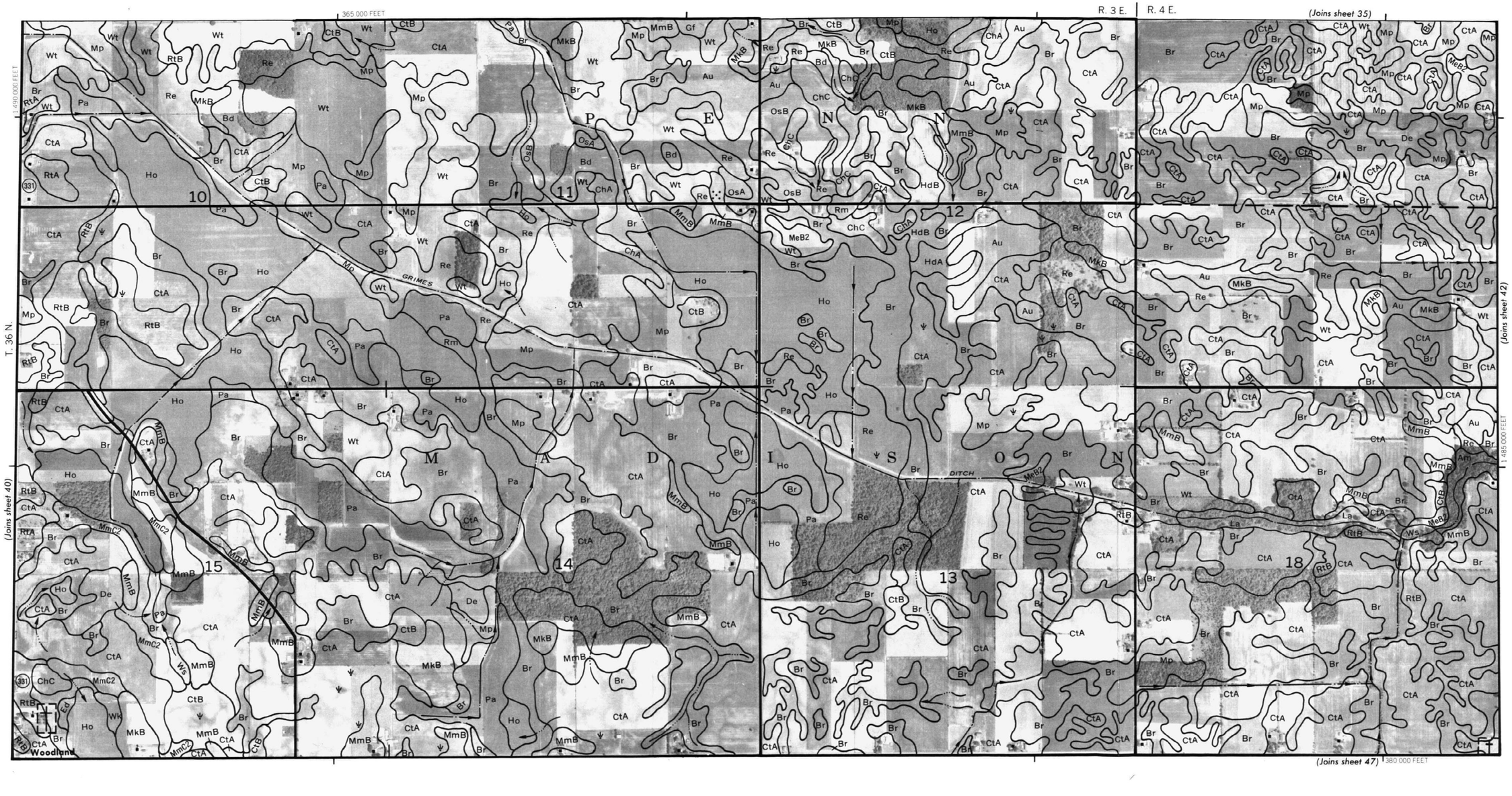
This map is compiled on 1971 aerial photography by the U. S. Department of Agriculture Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned

40



This map is compiled on 1971 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

ST. JOSEPH COUNTY, INDIANA NO. 40

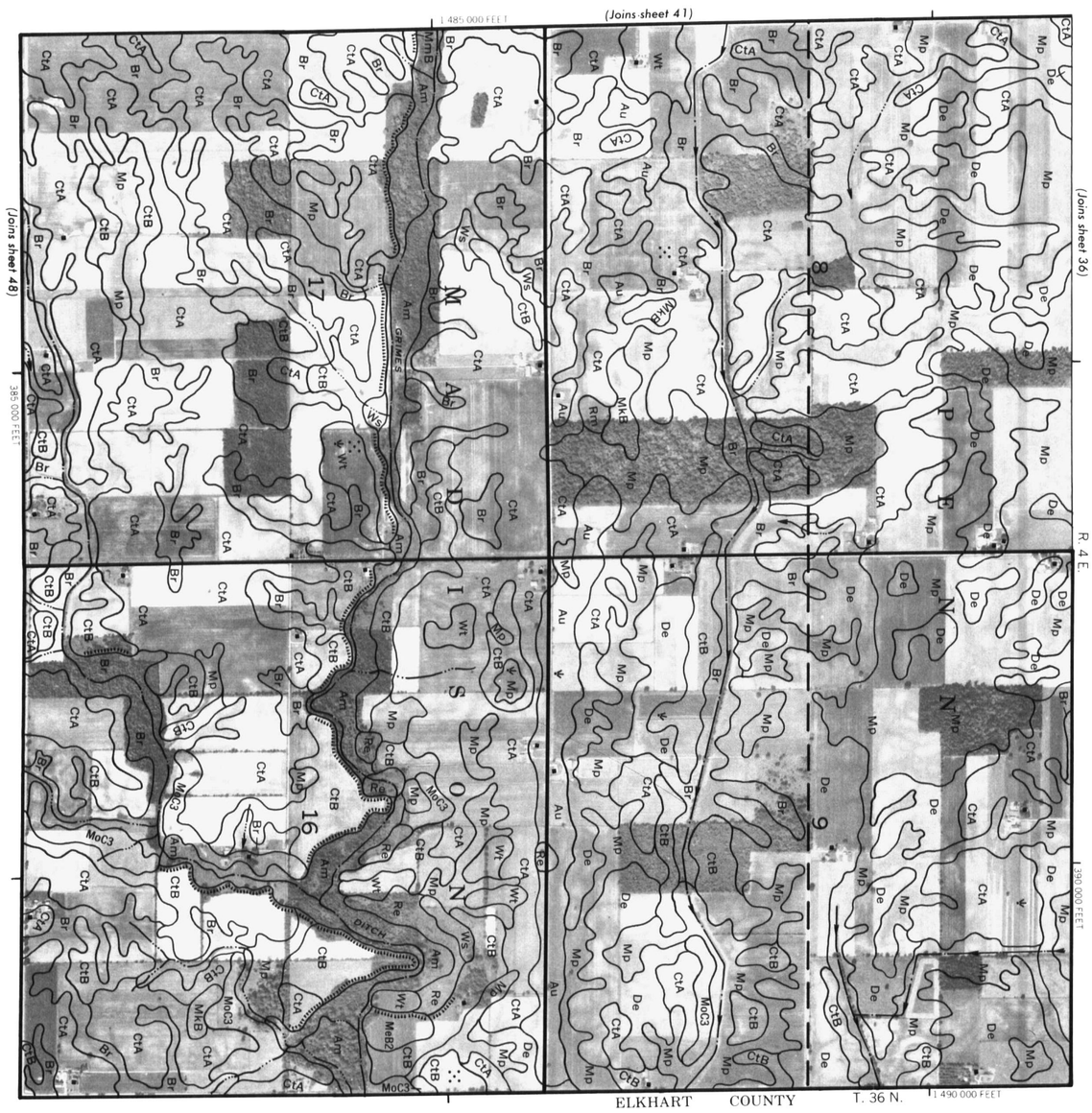


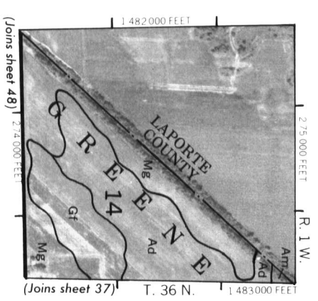
1 Mile 1 ¾ ½ ¼ 0

5 000 4 000 3 000 2 000 1 000 0 5 000 Feet

Scale 1:15 840

N

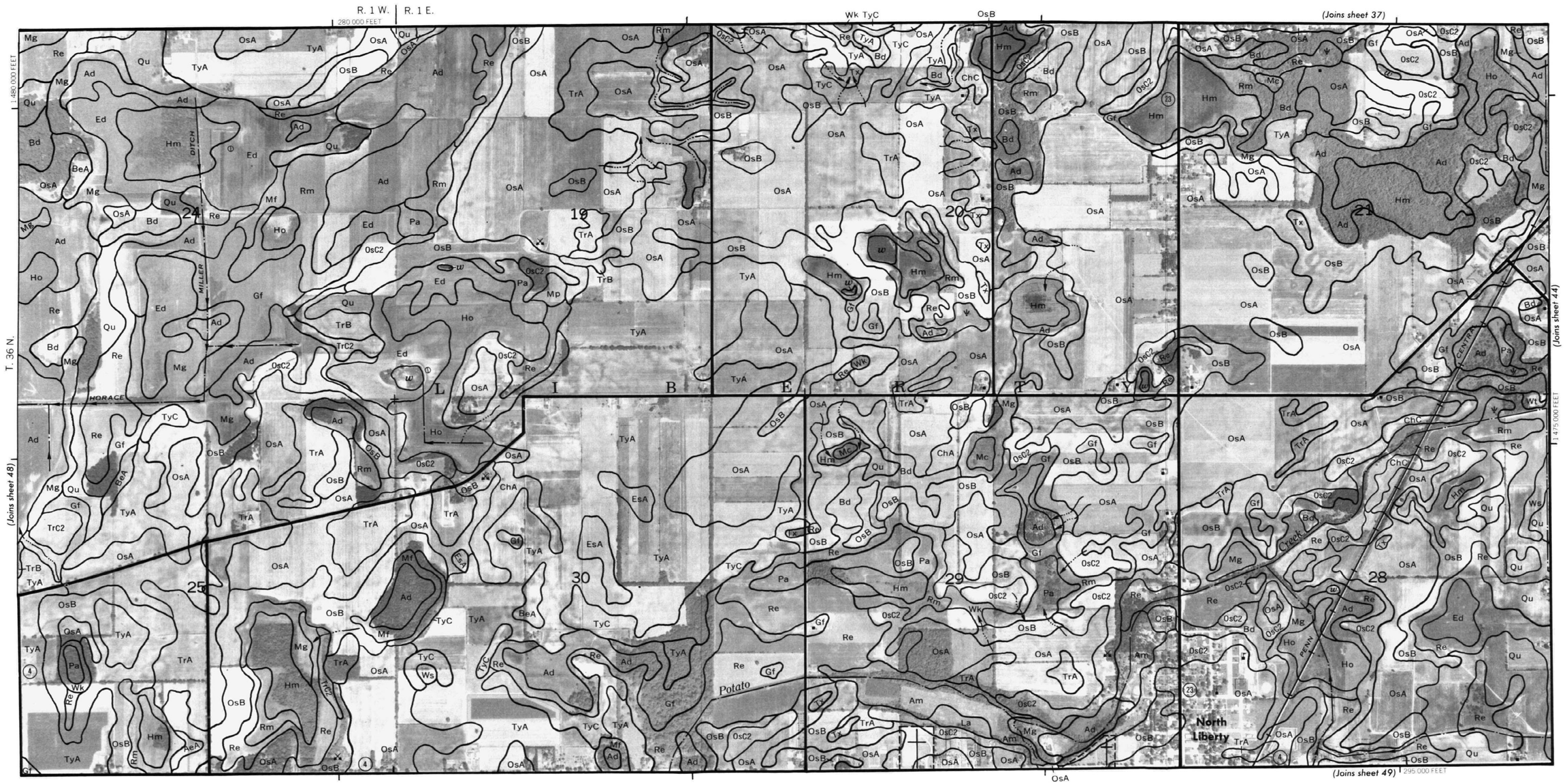




ST. JOSEPH COUNTY, INDIANA — SHEET NUMBER 42

This map is compiled on 1971 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

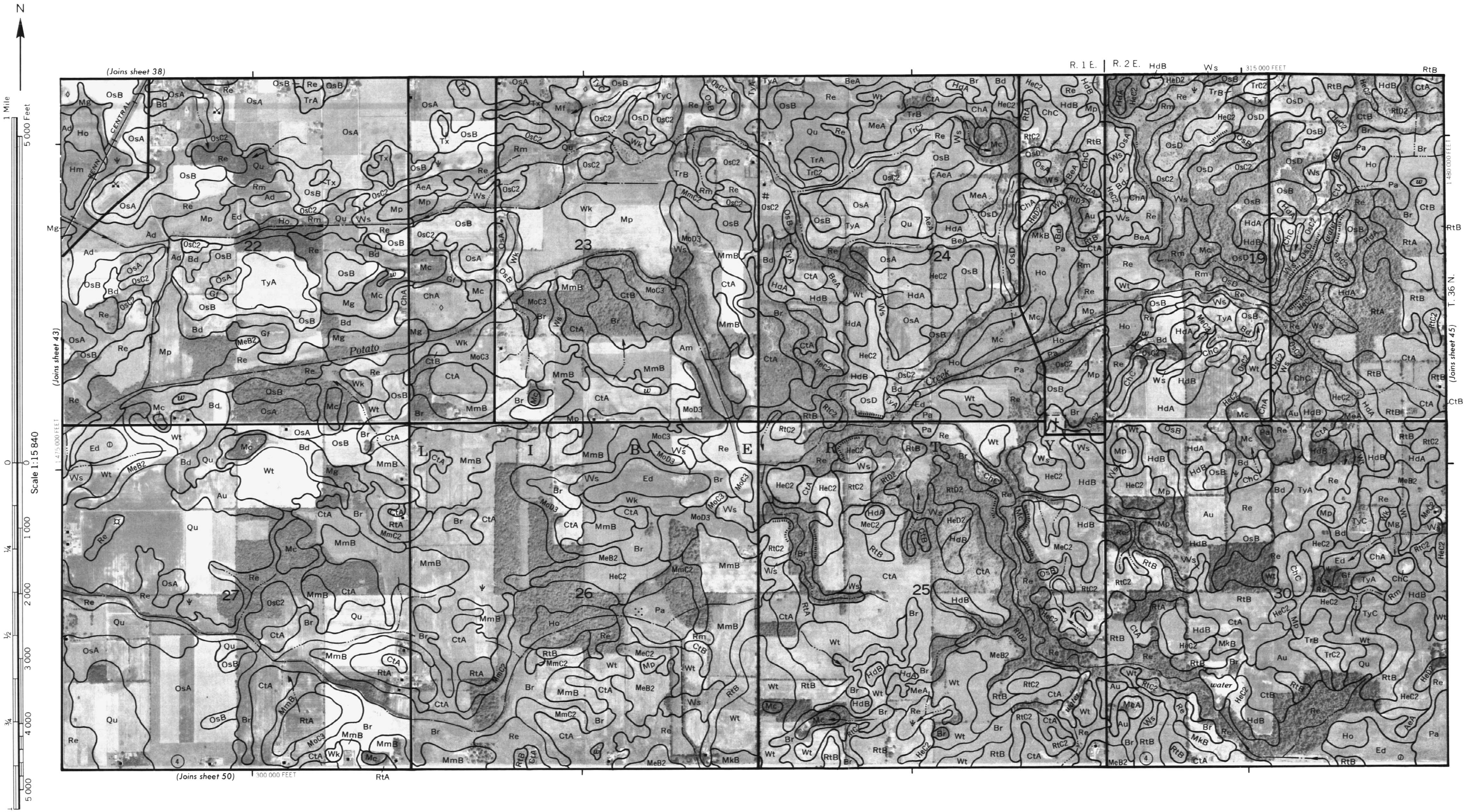
ST. JOSEPH COUNTY, INDIANA NO. 42



ST. JOSEPH COUNTY, INDIANA NO. 43

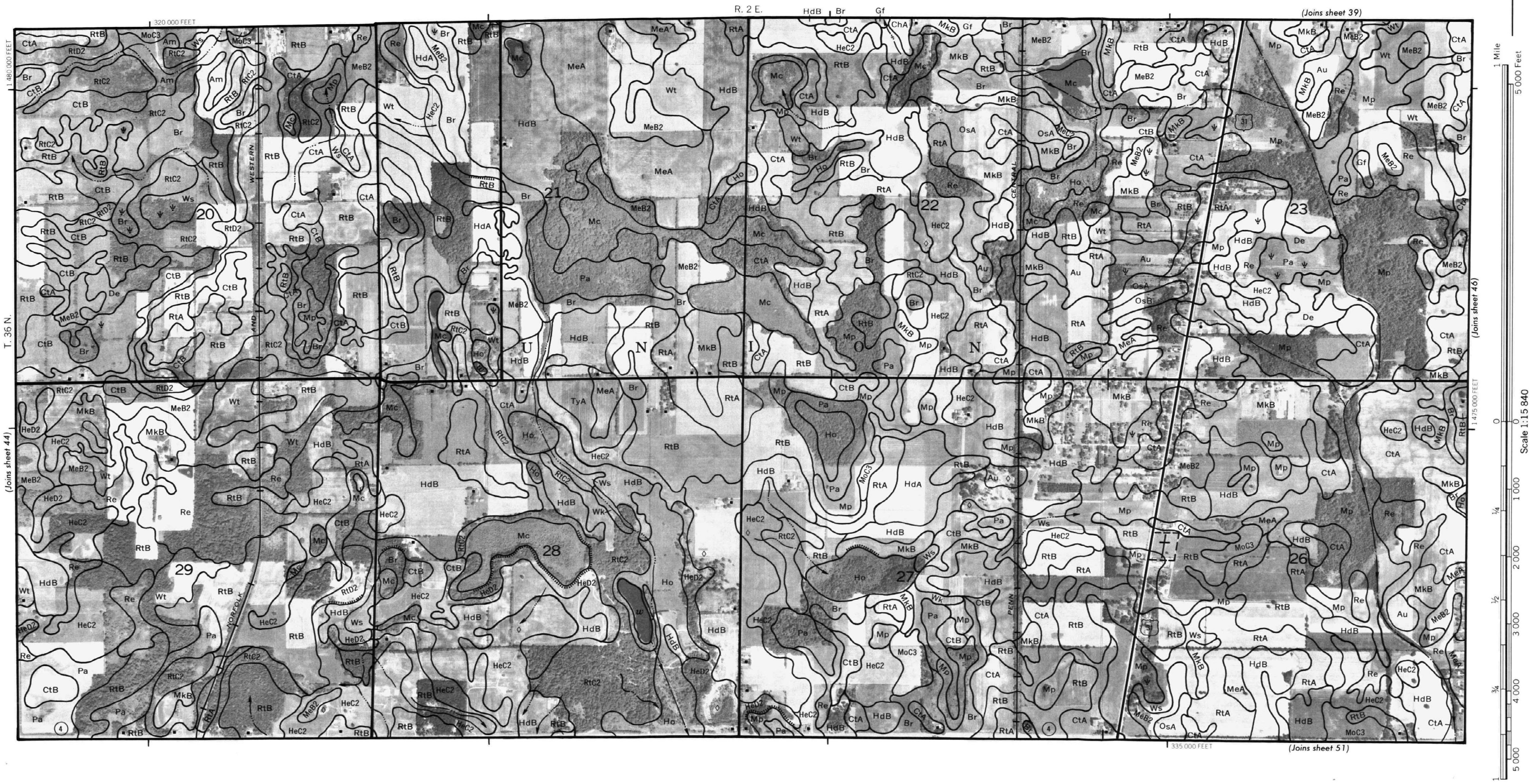
N

1 Mile
5 000 Feet
Scale 1:15 840



This map is compiled on 1971 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

ST. JOSEPH COUNTY, INDIANA NO. 44

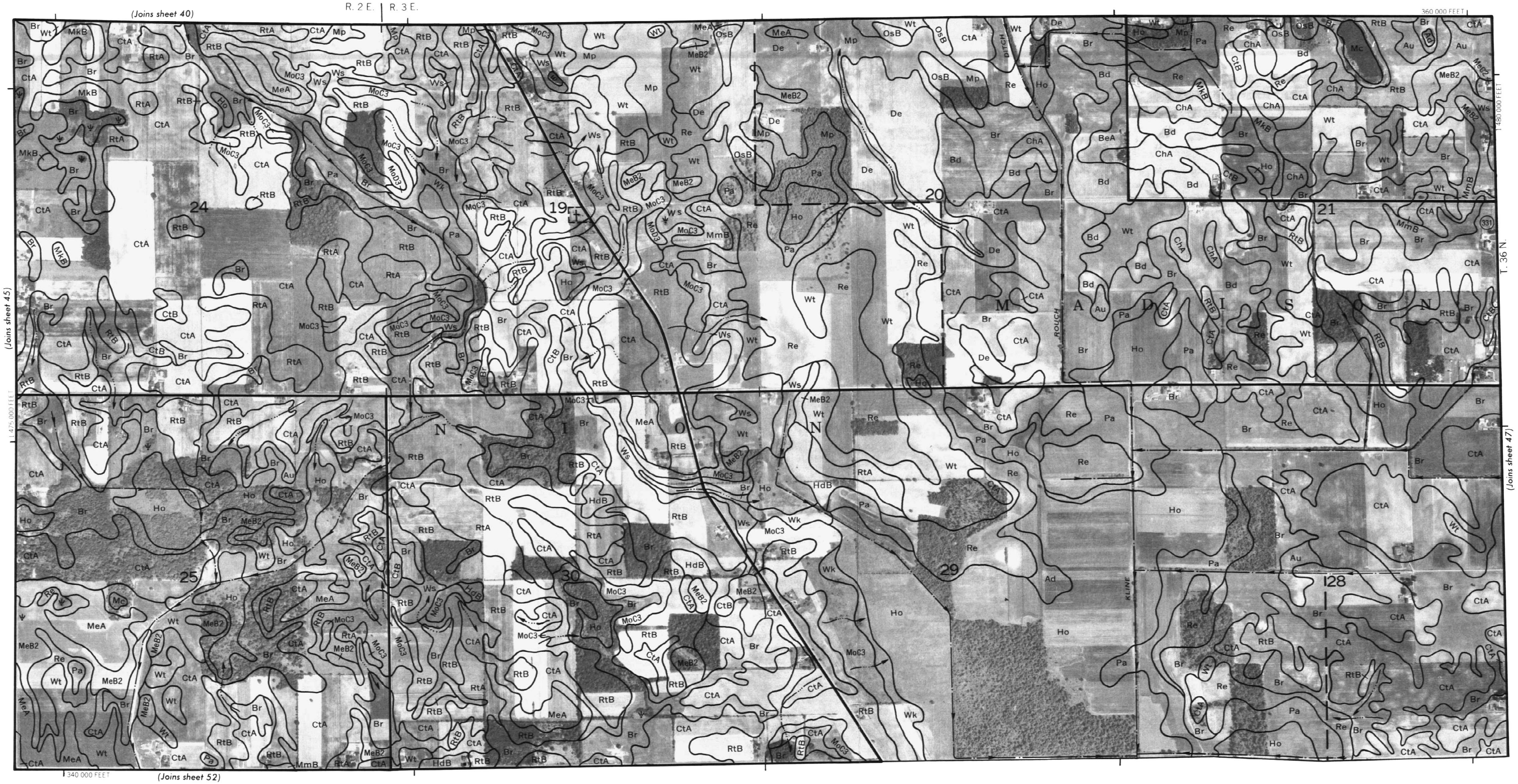


ST. JOSEPH COUNTY, INDIANA NO. 45

This map is compiled on 1971 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

46

N

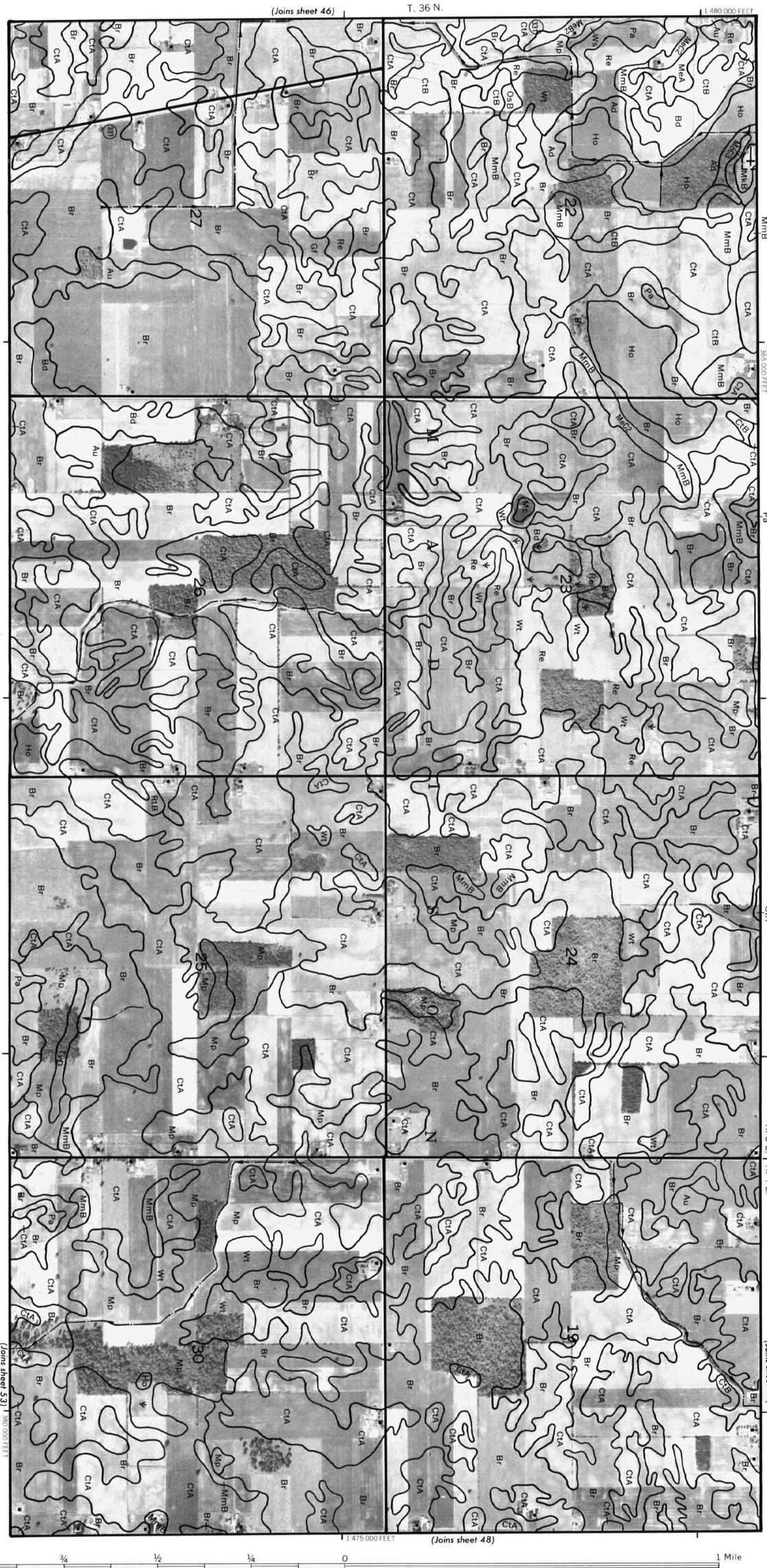


1 Mile
5 000 Feet
Scale 1:15 840
0 0
1/4 1 000
1/2 2 000 3 000
3/4 4 000
1 5 000

This map is compiled on 1971 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

ST. JOSEPH COUNTY, INDIANA NO. 47

This map is compiled on 1971 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned



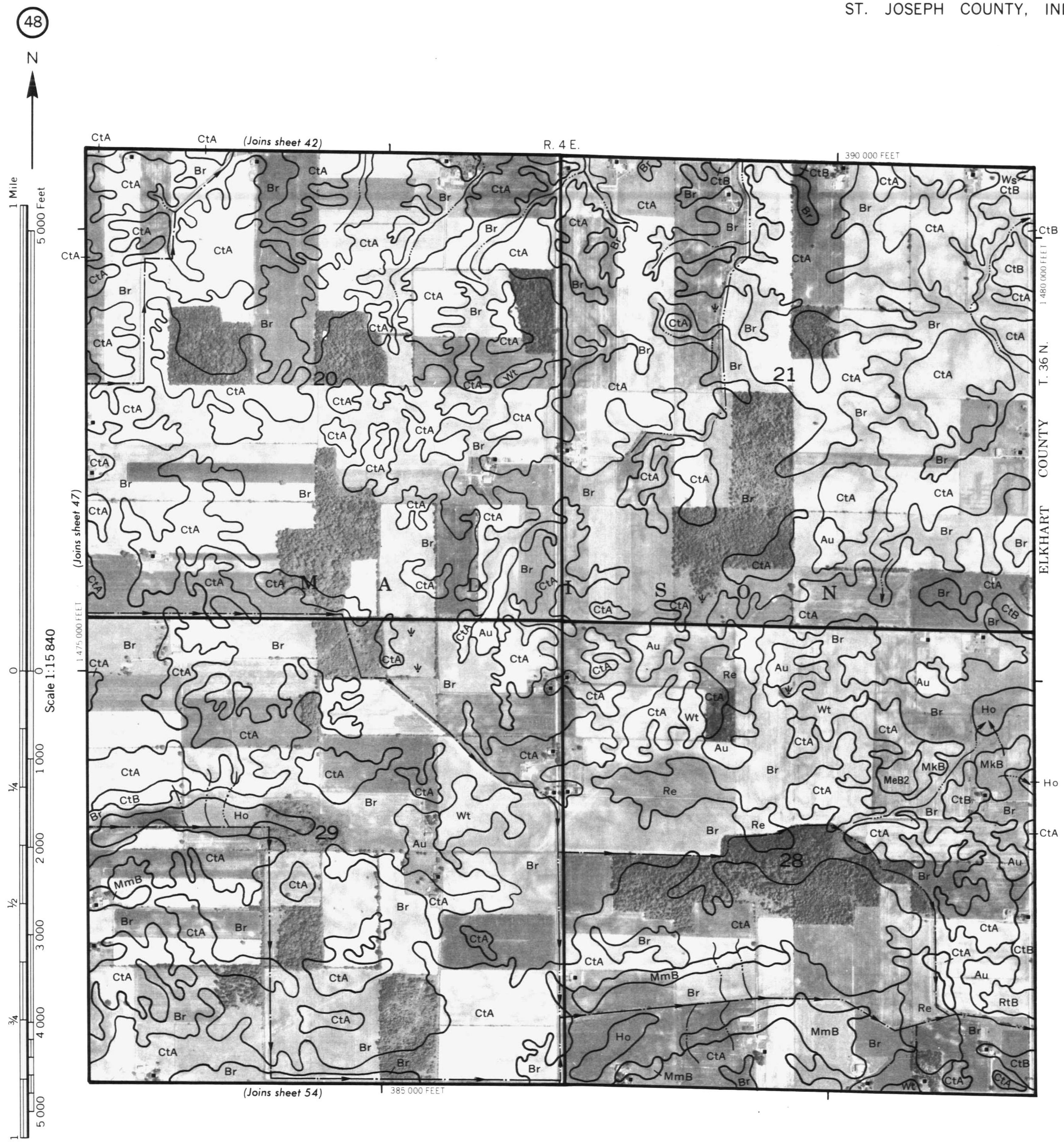
ST. JOSEPH COUNTY, INDIANA — SHEET NUMBER 47

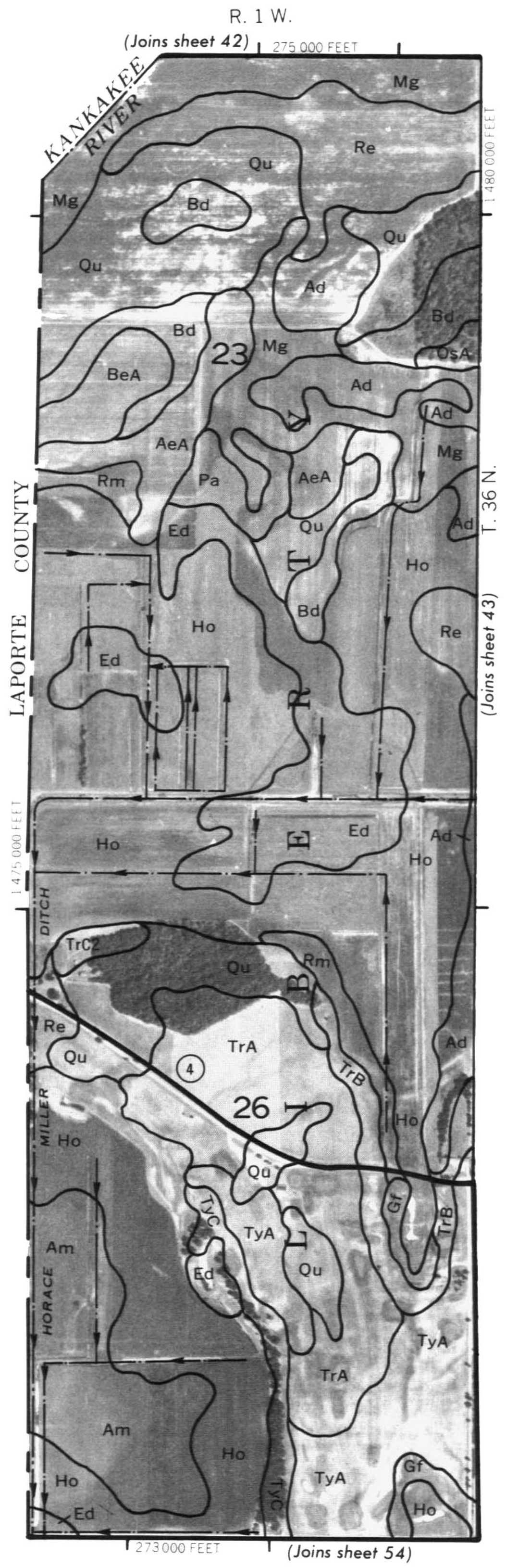
1 5 000 — ¾ 4 000 — ½ 3 000 — ¼ 2 000 — 0 1 000 — 0 1 Mile 5 000 Feet

Scale 1:15 840

N

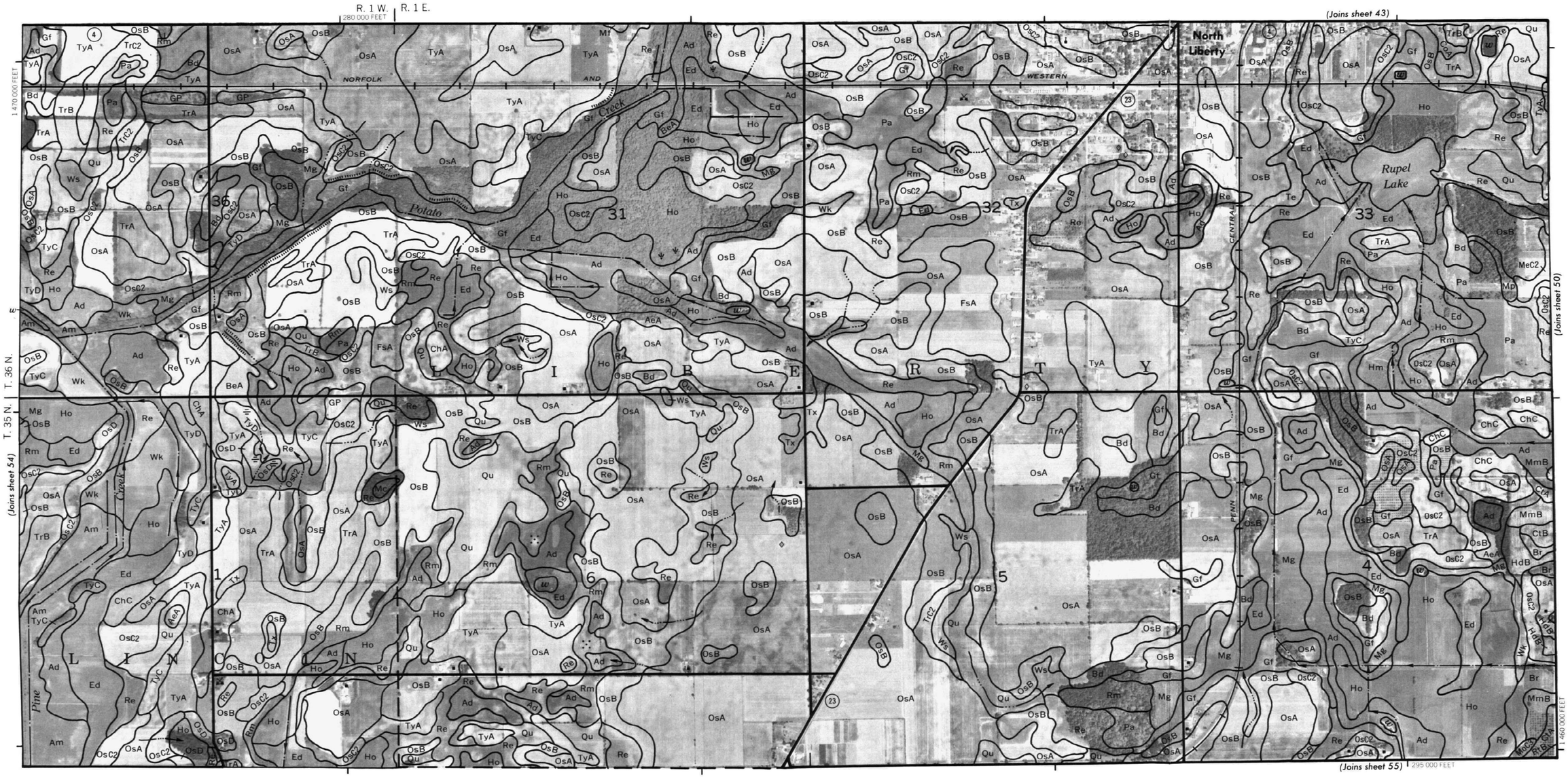
47





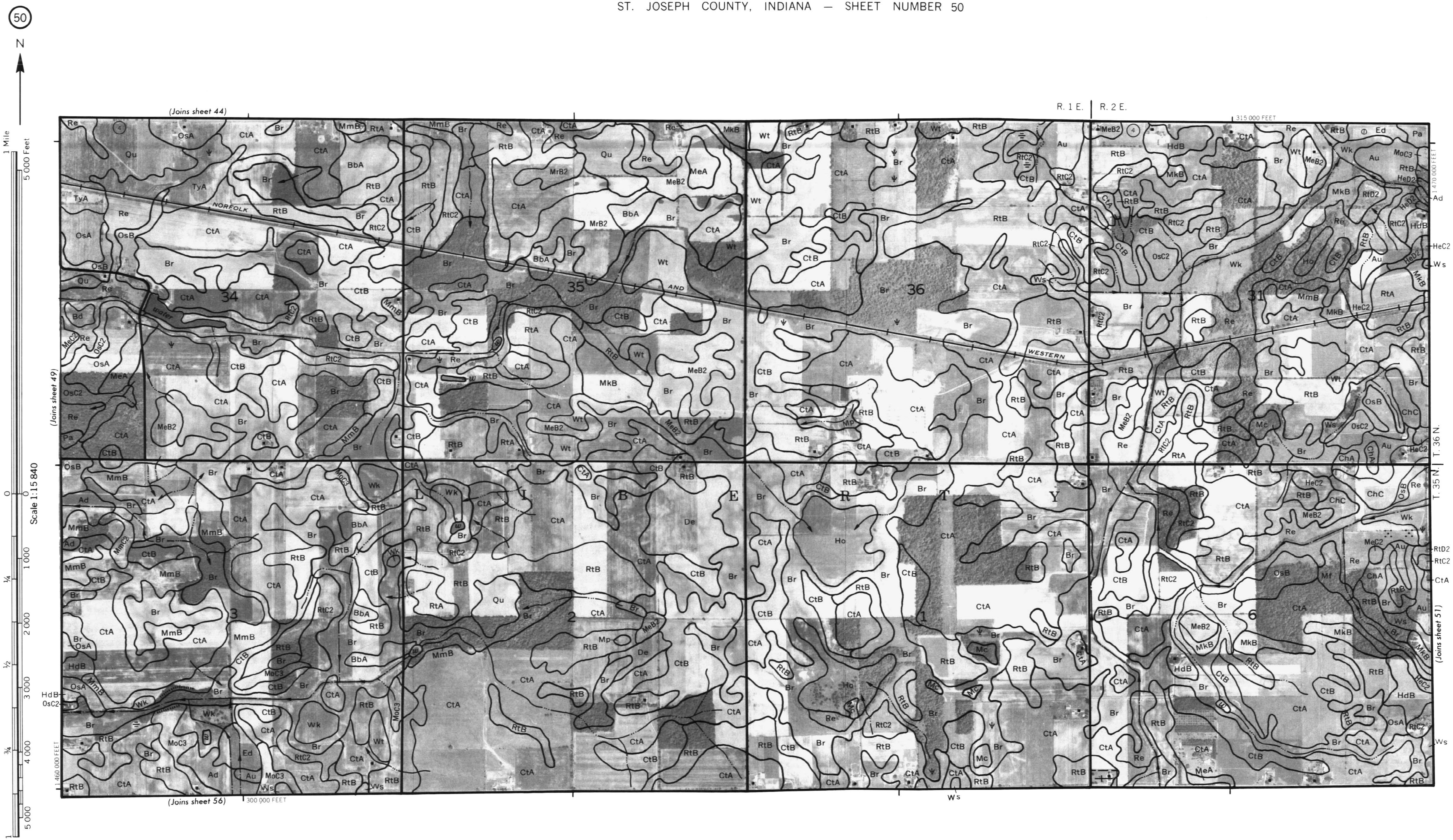
This map is compiled on 1971 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

ST. JOSEPH COUNTY, INDIANA NO. 48



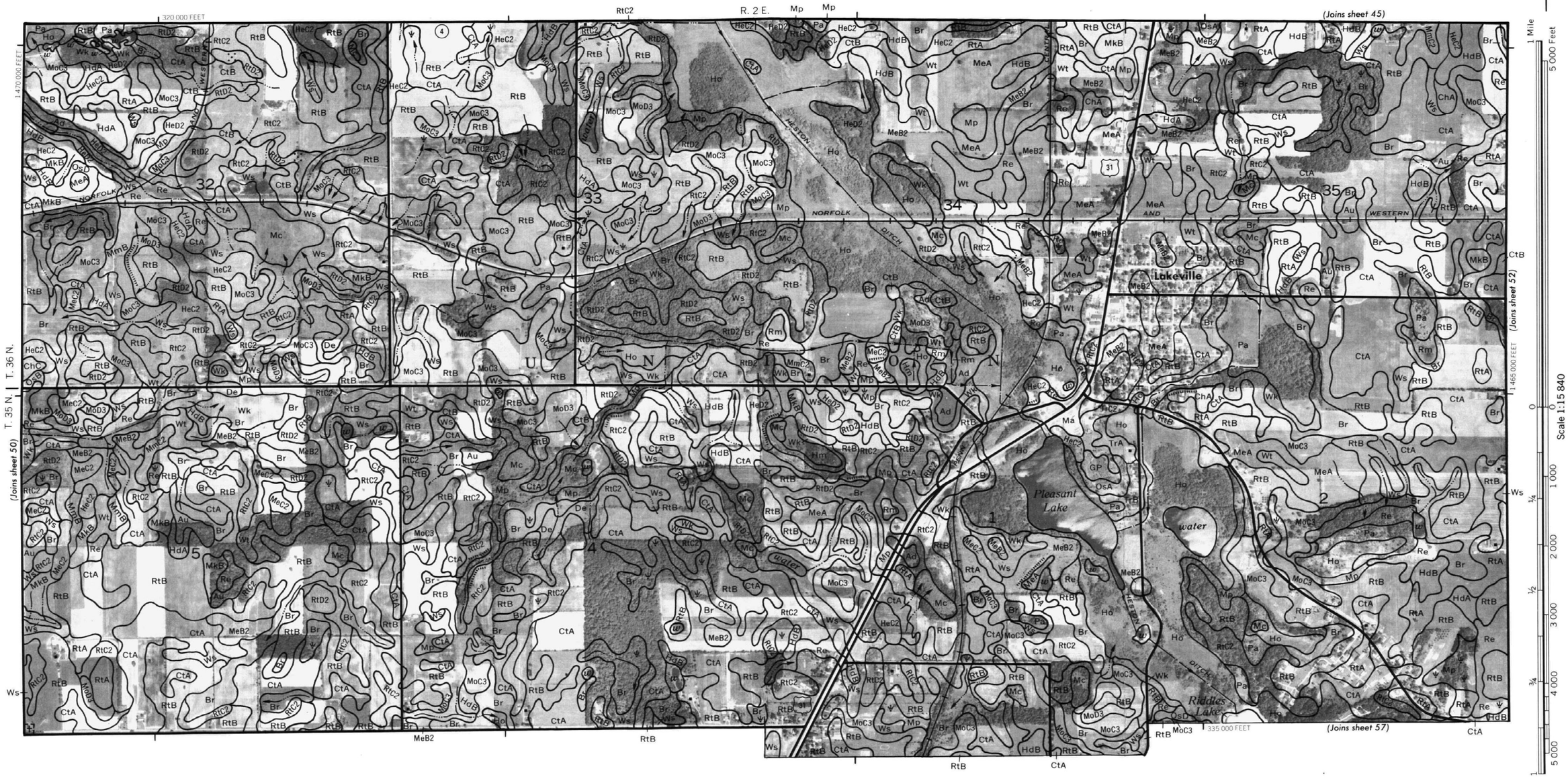
ST. JOSEPH COUNTY, INDIANA NO. 49

ST. JOSEPH COUNTY, INDIANA — SHEET NUMBER 50

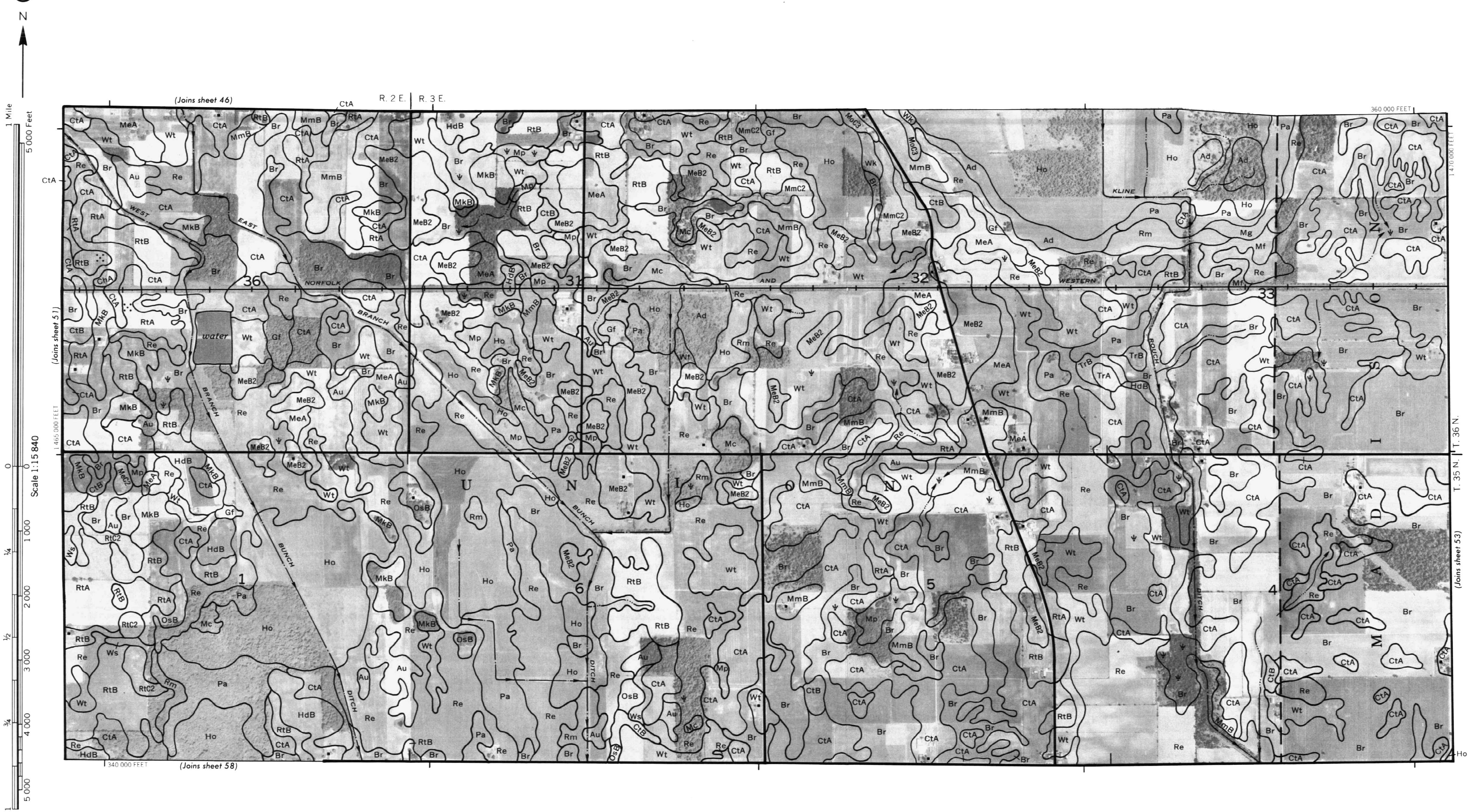


This map is compiled on 1971 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

ST. JOSEPH COUNTY, INDIANA NO. 50

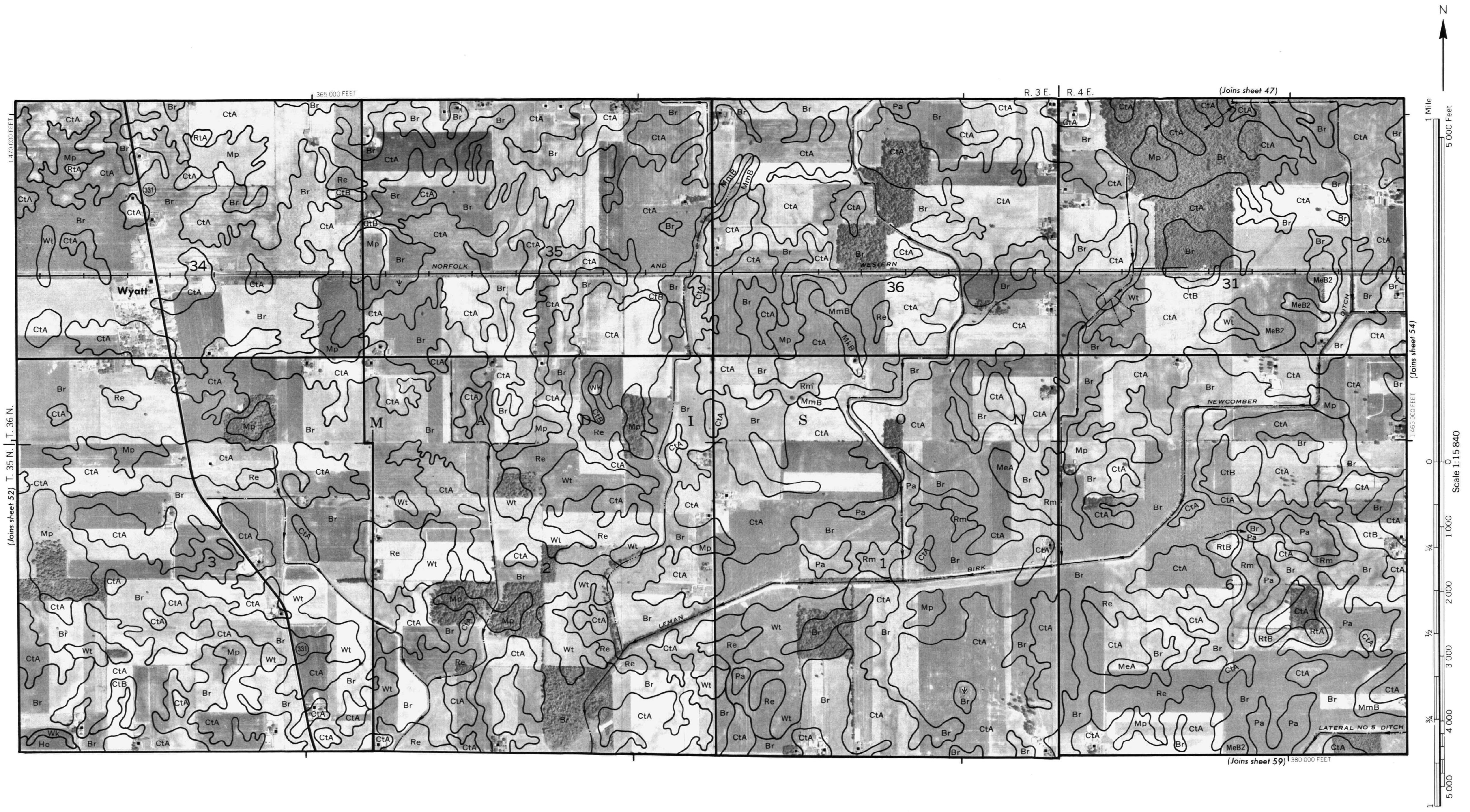


ST. JOSEPH COUNTY, INDIANA NO. 51



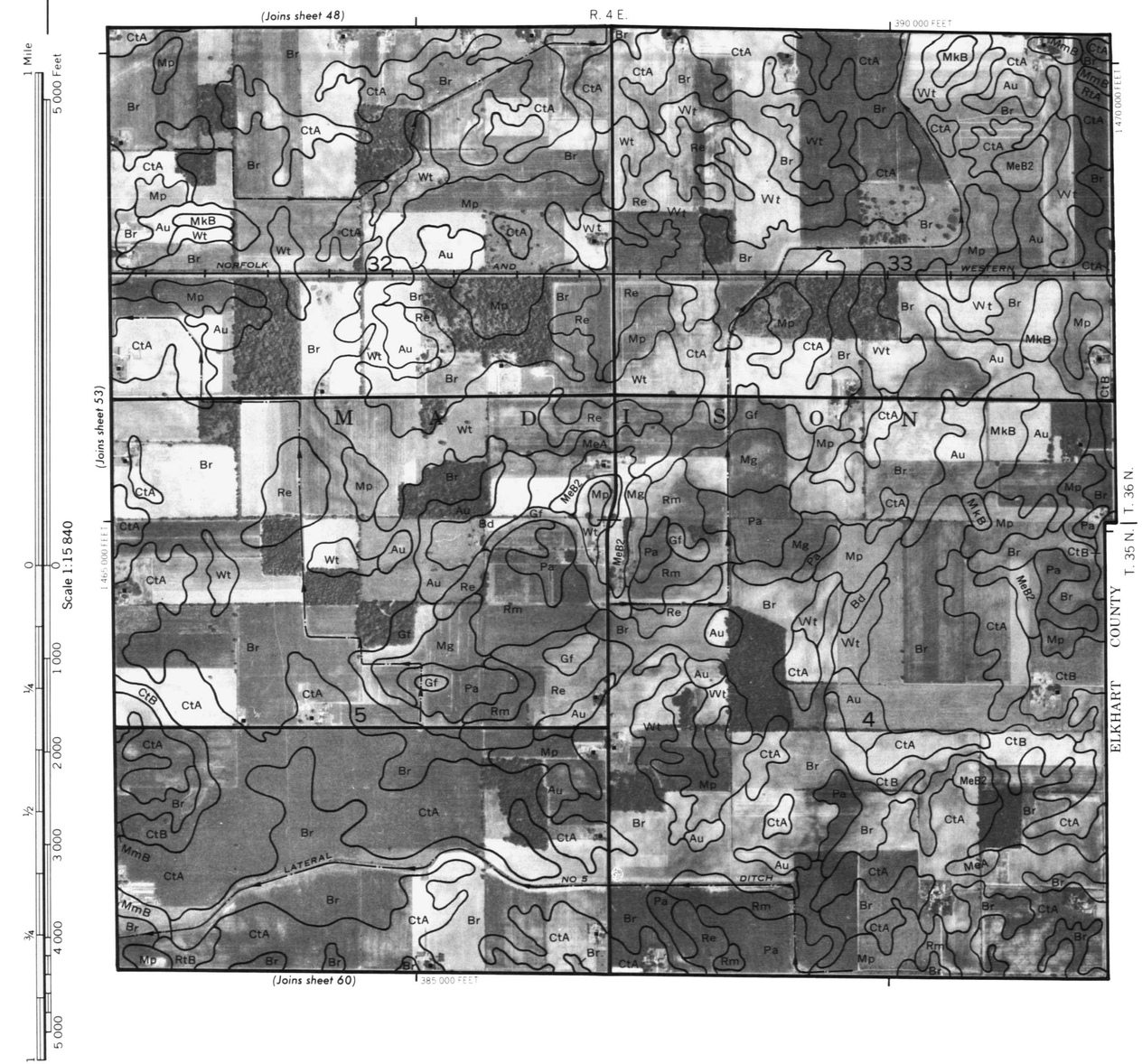
This map is compiled on 1971 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

ST. JOSEPH COUNTY, INDIANA, NO. 52



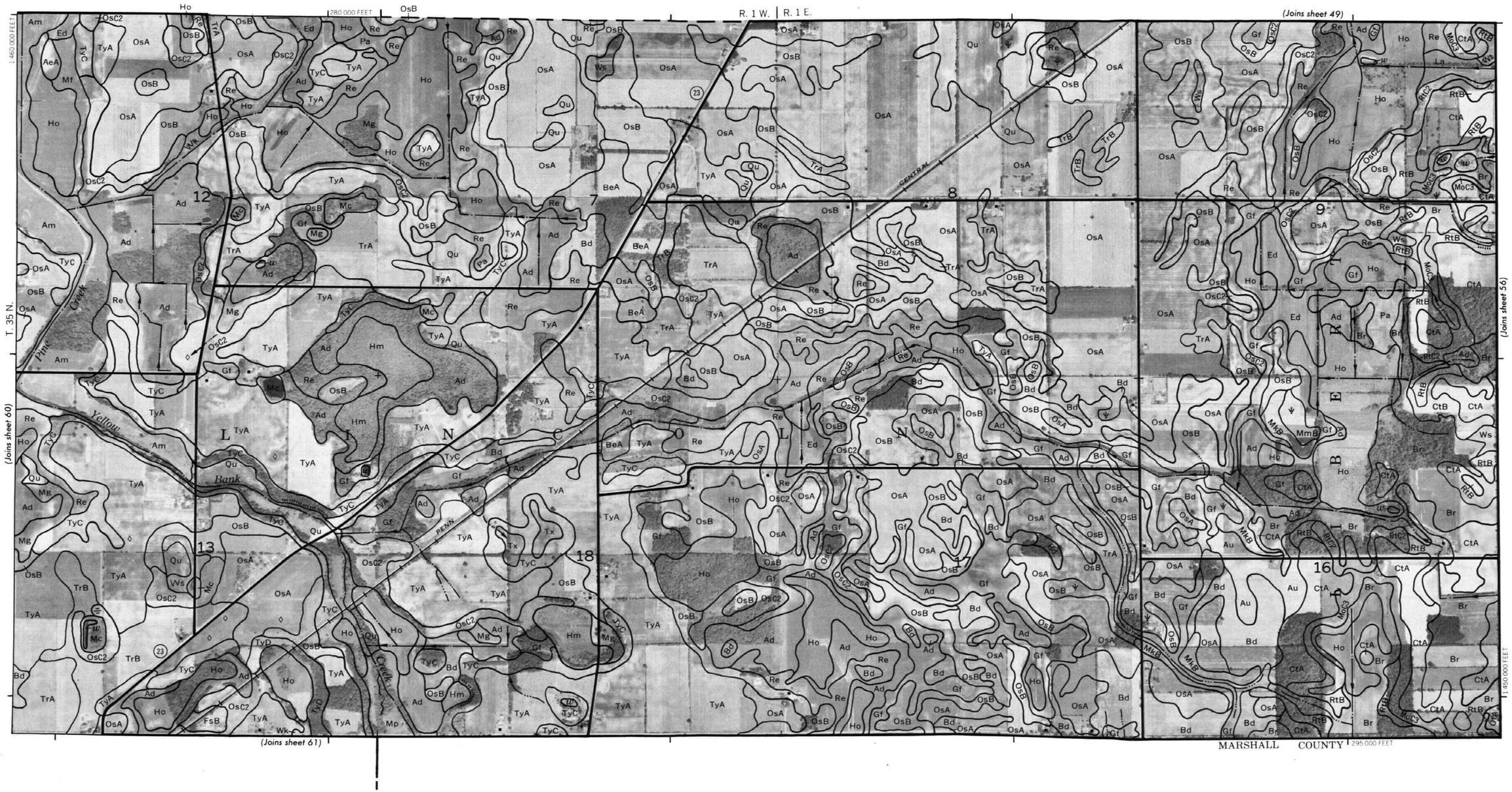
ST. JOSEPH COUNTY, INDIANA NO. 53

This map is compiled on 1971 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



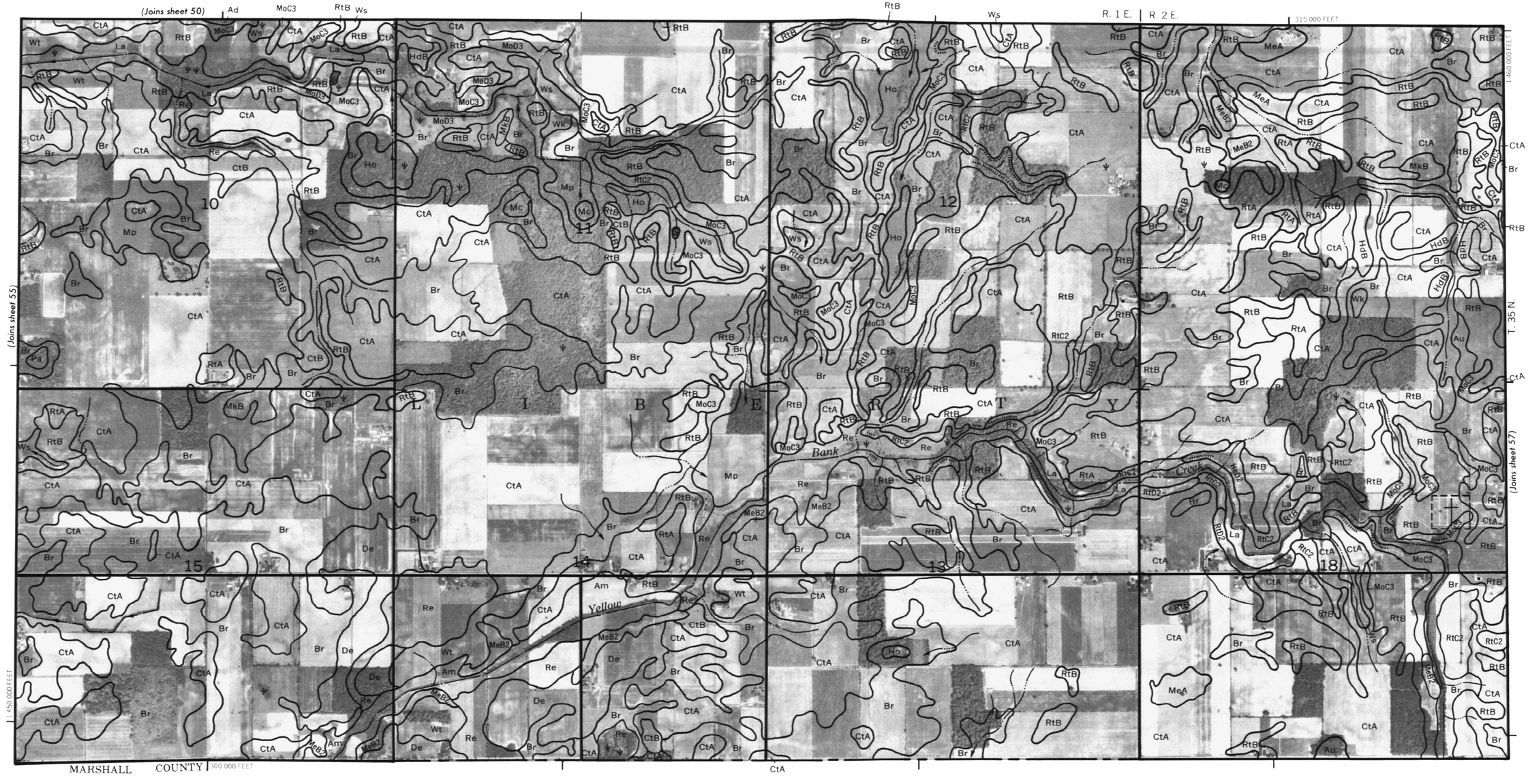
This map is compiled on 1971 aerial photography by the U. S. Department of Agriculture Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned

ST. JOSEPH COUNTY, INDIANA NO. 54



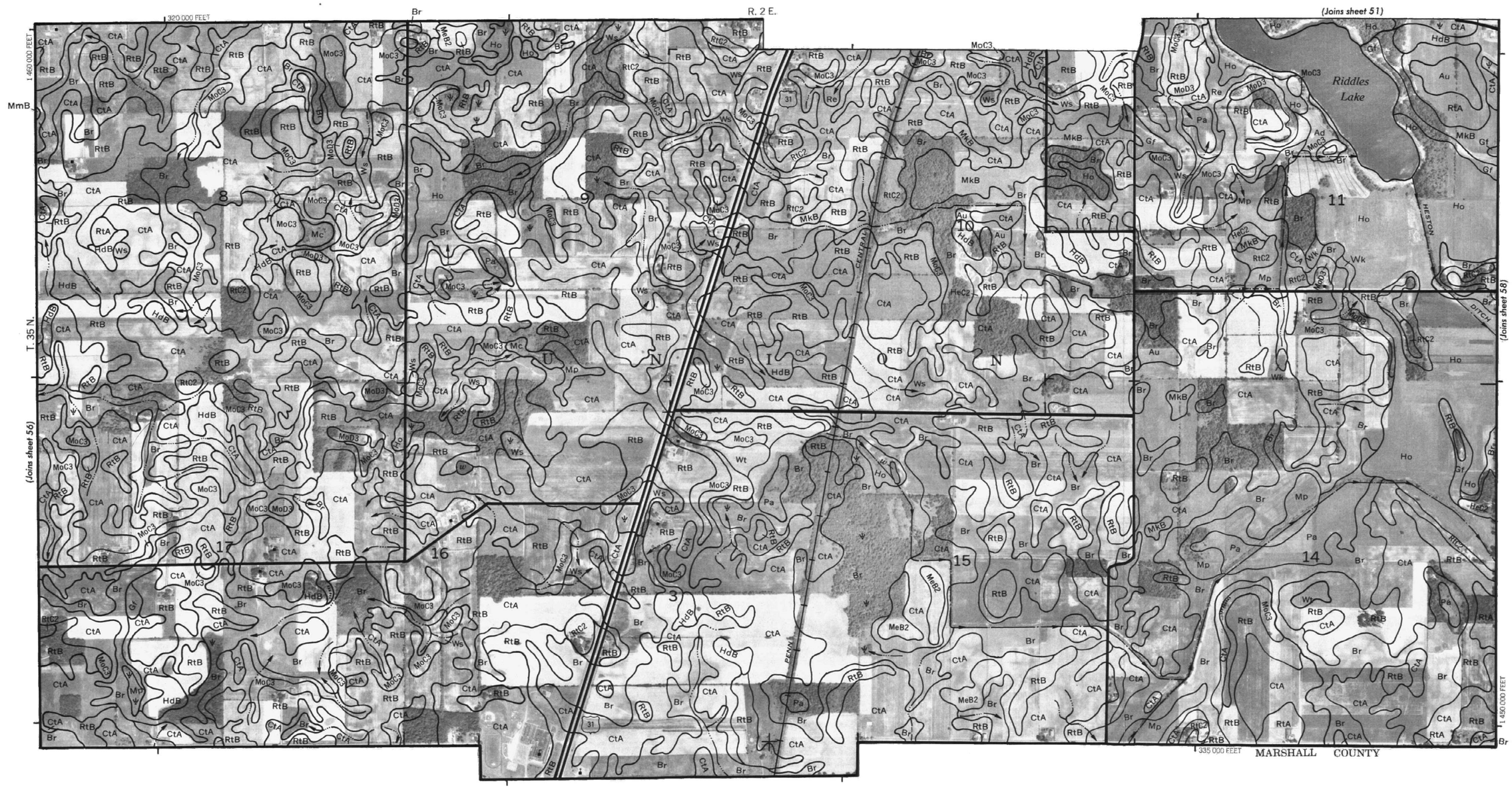
ST. JOSEPH COUNTY, INDIANA NO. 55

This map is compiled on 1971 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned



This map is compiled on 1971 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

ST. JOSEPH COUNTY, INDIANA — SHEET NUMBER 57



57

N

1 Mile

5 000 Feet

Scale 1:15 840

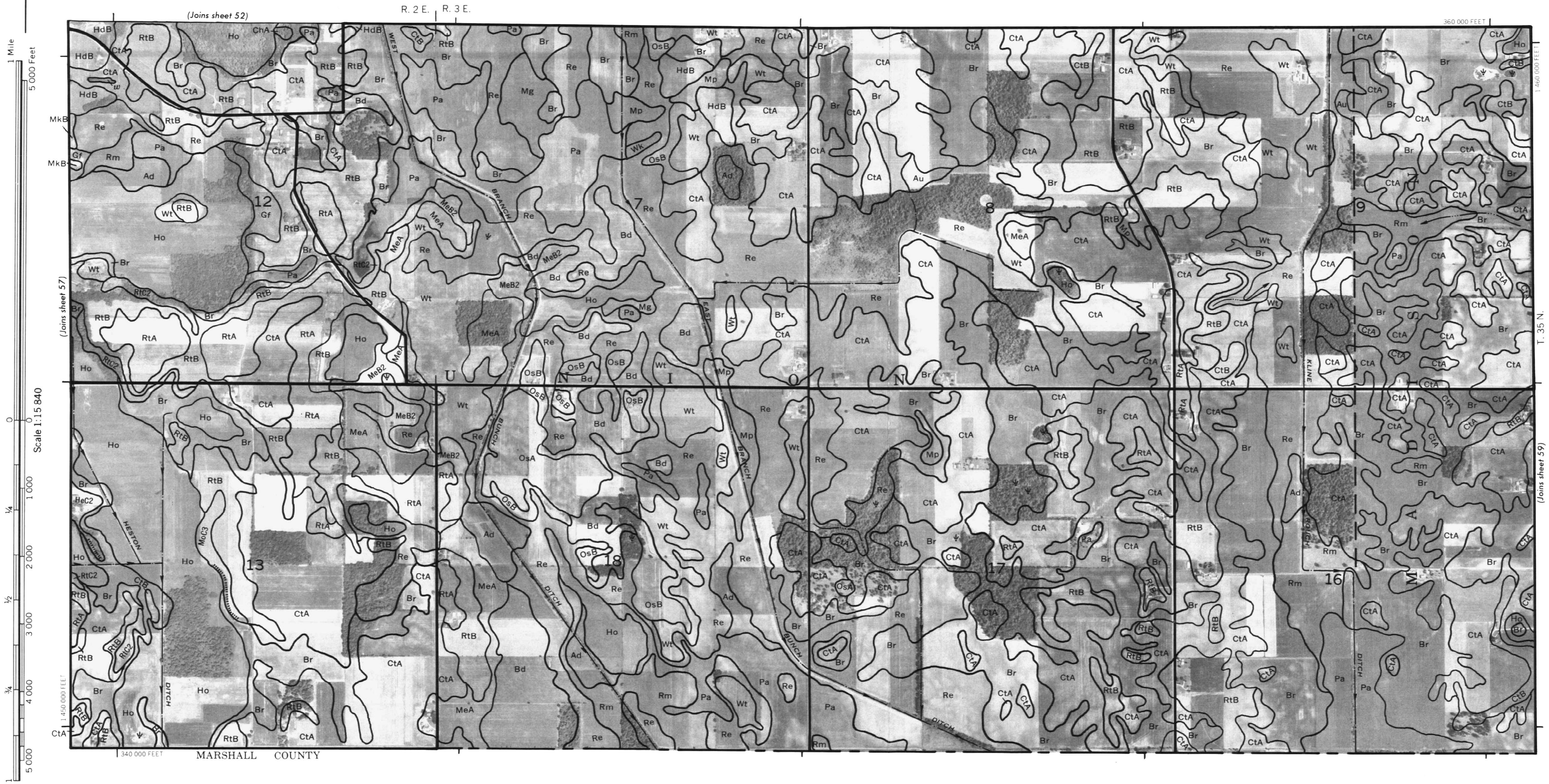
0 ¼ ½ ¾ 1

1 000 2 000 3 000 4 000 5 000

ST. JOSEPH COUNTY, INDIANA NO. 57

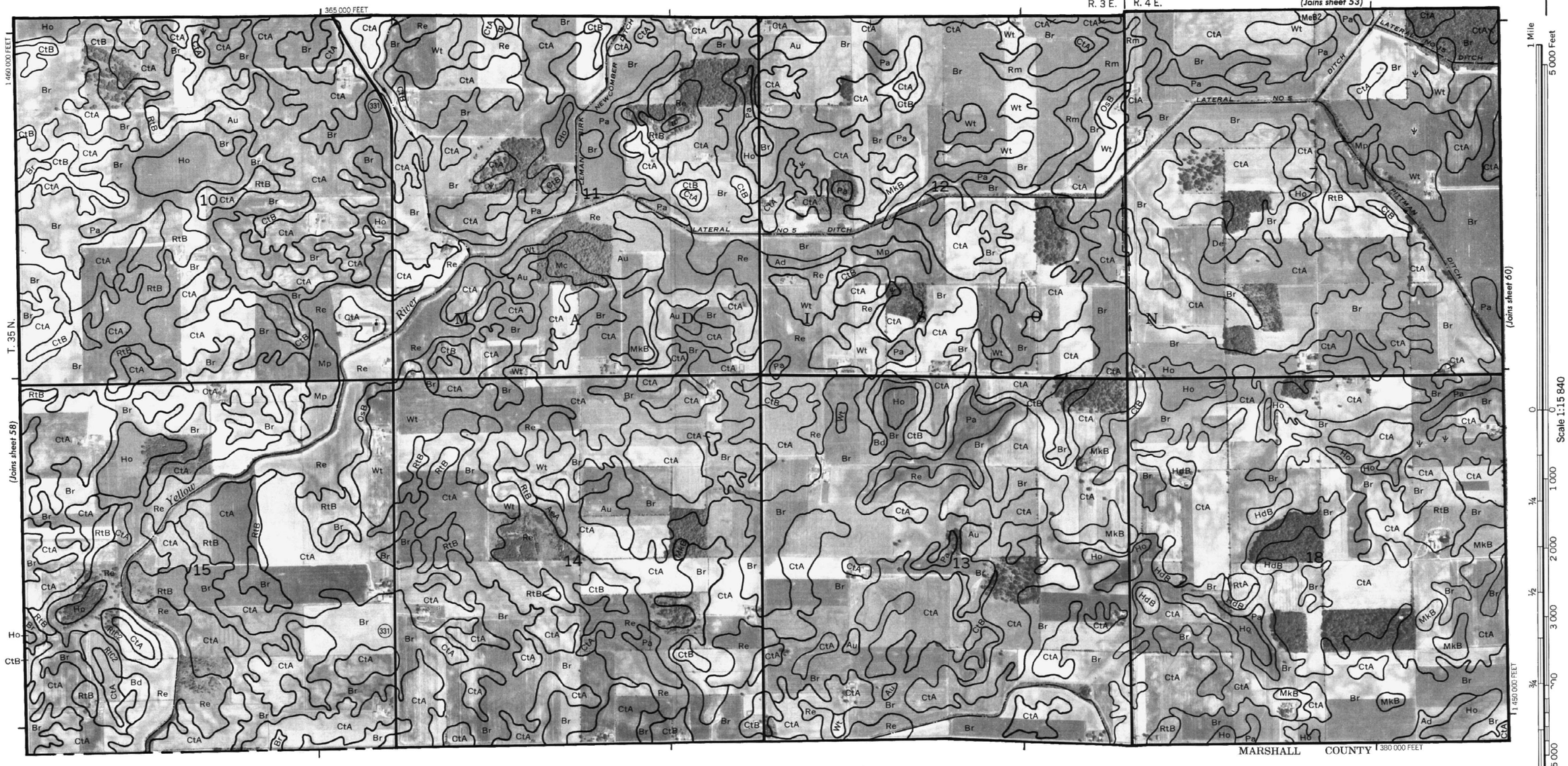
This map is compiled on 1971 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid 10x10 and land division corners, if shown, are approximately positioned.

ST. JOSEPH COUNTY, INDIANA — SHEET NUMBER 58



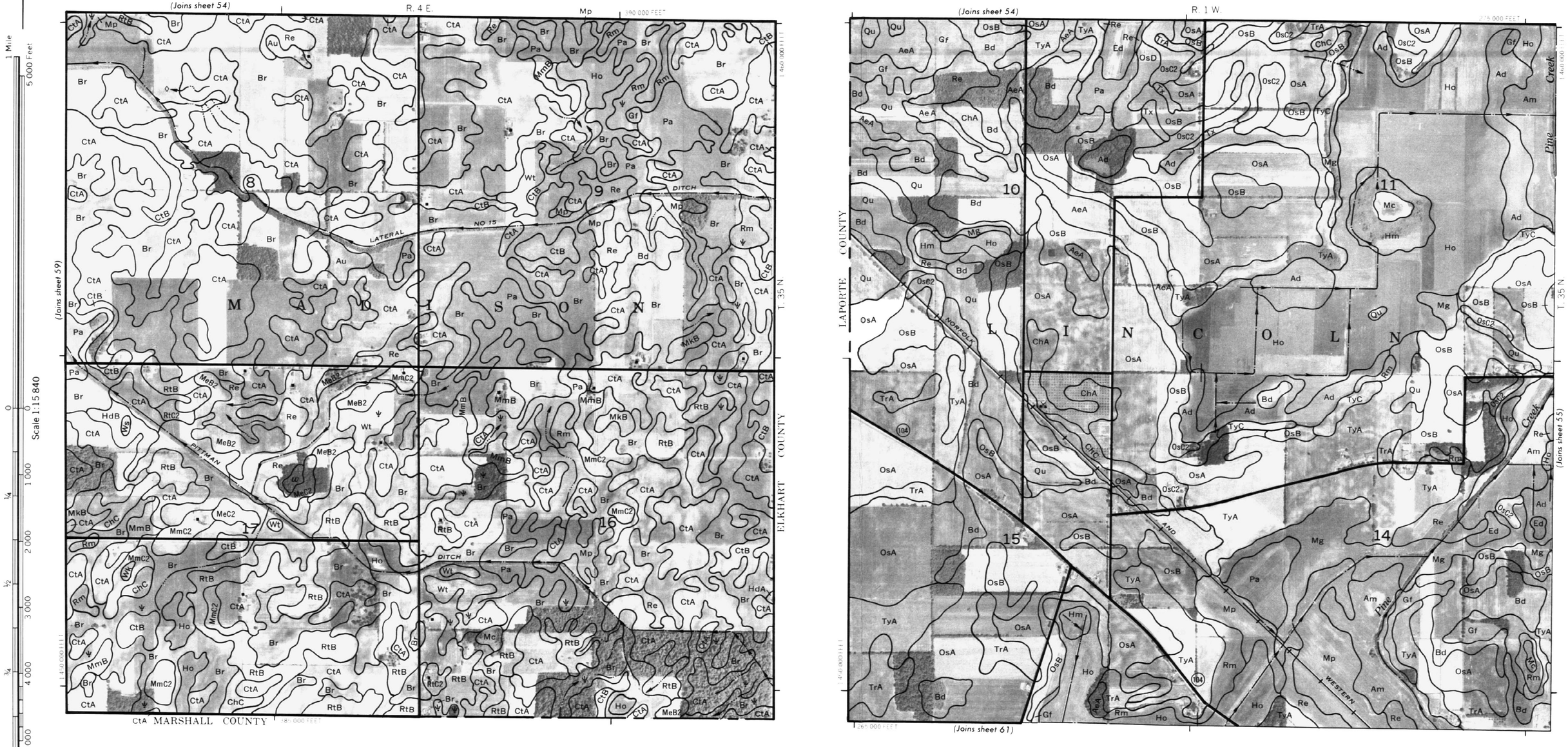
This map is compiled on 1971 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

ST. JOSEPH COUNTY, INDIANA NO. 58



ST. JOSEPH COUNTY, INDIANA NO. 59

an 1971 aerial photography by the U. S. Department of Agriculture. Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

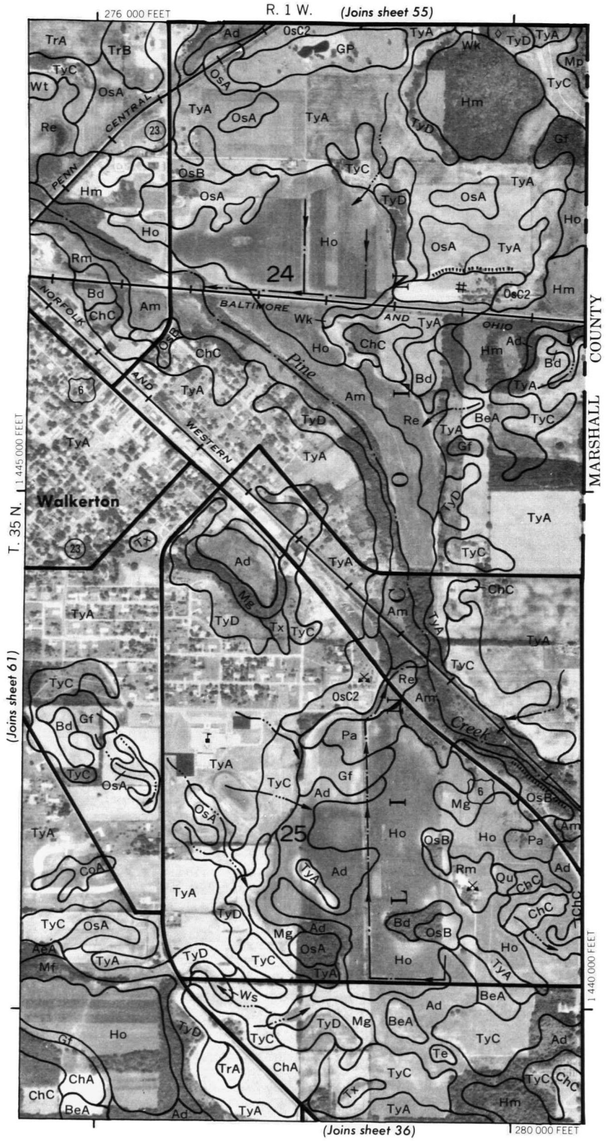


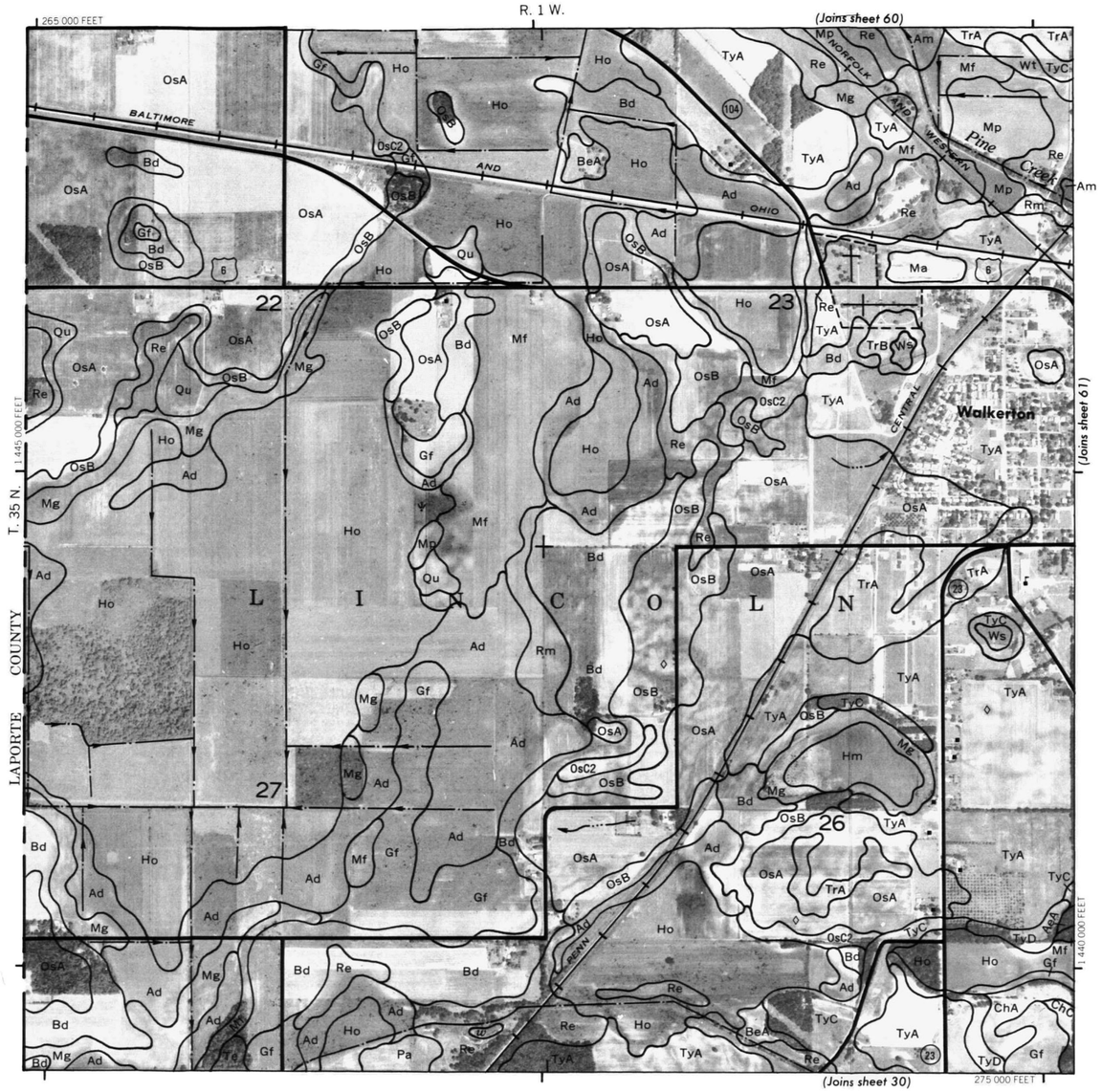
This map is compiled on 1961 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid lines and land division corners if shown are approximately positioned.

ST. JOSEPH COUNTY, INDIANA NO. 60

ST. JOSEPH COUNTY, INDIANA NO. 61

This map is compiled on 1971 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned





61

N

1 Mile
5 000 Feet
Scale 1:15 840